THE VIDEO GAMES TEXTBOOK

[HISTORY • BUSINESS • TECHNOLOGY]

Dr. Brian J. Wardyga

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History • Business • Technology

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List of Abbreviations

2D	Two-Dimensional
3D	Three-Dimensional
3G	Third Generation
4G	Fourth Generation
64DD	Nintendo 64 Disk Drive
AAR	After Action Review
ADF	Australian Defence Force
AES	Advanced Entertainment System
AGS	Asia Game Show
AI	Artificial Intelligence
AMD	Advanced Micro Devices
ANTIC	Alphanumeric Television Interface Controller
AO	ESRB: Adults Only
APA	American Psychological Association
API	Application Programming Interface
APU	Accelerated Processing Unit
AR	Augmented Reality
ARM	Advanced RISC Machines
ASA	Advertising Standards Authority
ASCII	American Standard Code for Information Interchange
ASIC	Application-Specific Integrated Circuit
ASL	Advanced Squad Leader
ATI	Array Technology Inc.
AT&T	American Telephone and Telegraph Company
AVS	Advanced Video System
BASIC	Beginner's All-purpose Symbolic Instruction Code
BD-ROM	Blu-ray Disc ROM
BGS	Brasil Game Show
BIOS	Basic Input/Output System
Bit/b	Binary Digit
BREW	Binary Runtime Environment for Wireless
CAD	Computer-Aided Design
CD	Compact Disc
CES	Consumer Electronics Show
CF	CompactFlash
COLECO	Connecticut Leather Company
Compaq	Compatibility and Quality
COTS	Commercial Off-The-Shelf
CP/M	Control Program/Monitor
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CSSC	Clinical Skills and Simulations Center
CTIA	Color Television Interface Adaptor
CTR	Computing-Tabulating-Recording Company
DARPA	Defense Advanced Research Projects Agency
DAT	Digital Audio Tape
DDP	Digital Data Pack
DDR	Dance Dance Revolution
DLC	Downloadable content
DLNA	Digital Living Network Alliance
DMA	Direct Memory Access
DOS	Disk Operating System
DRAM	Dynamic Random-Access Memory
DRM	Digital Rights Management
DSP	Digital Signal Processor
DTS	Dedicated to Sound
DVD	Digital Versatile Disc
DVI	Digital Visual Interface
DVR	Digital Video Recorder
DWGE	Dubai World Game Expo
E	ESRB: Everyone
E3	Entertainment Expo
E10+	ESRB: Everyone 10+
EA	Electronic Arts
EC	ESRB: Early Childhood
ED	Enhanced Definition
EDSAC	Electronic Delay Storage Automatic Calculator
EEDAR	Electronic Entertainment Design and Research
EGA	Enhanced Graphics Adapter

ESA	Entertainment Software Association
ESL	Electronic Sports League
ESP	Extra Sensory Perception
ESRB	Entertainment Software Rating Board
EST	Engagement Skills Trainer
EVO	Evolution Championship Series
F.A.T.S	FireArms Training Simulator
F2P	Free-To-Play
FEPA	Family Entertainment Protection Act
FLOPS	Floating Point Operations Per Second
FMV	Full Motion Video
FPU	Floating-Point Unit
fps	Frames Per Second
FPS	First-Person Shooter
FSW	Full Spectrum Warrior
FTC	Federal Trade Commission
GAA	Game After Ambush
GB	Gigabyte
GBA	Game Boy Advance
GBC	Game Boy Color
GBL	Game-Based Learning
GCC	General Consumer Corporation
GCN [NGC in Japan]	GameCube
GDC	Game Developers Conference
GD-ROM	Gigabyte Disc
GE	General Electric
GFLOPS	Gigaflops
GFX	Graphics
GG	Game Gear
GHz	Gigahertz
GMod	Garry's Mod
GPRS	General Packet Radio Service
GPU	Graphics Processing Unit
GSM	Groupe Spécial Mobile
GTIA	Graphic Television Interface Adaptor
GUI	Graphical User Interface
GWAP	Game with a Purpose
HDD	Hard Disk Drive
HDMI	High-Definition Multimedia Interface
HDTV	High Definition Television
HDV	High Definition Video
HPS	high-fidelity patient simulations
HUD	Heads Up Display
Hz	Hertz
I/ITSEC	Interservice/Industry Training, Simulation and Education Conference
I/O	Input and Output
IBM	International Business Machines
ICT	Institute for Creative Technologies
IDSA	Interactive Digital Software Association
IEM	Intel Extreme Masters
INTV	Intellivision Inc.
IP	Intellectual Property
iOS	iPhone Operating System
ISFE	Interactive Software Federation of Europe
J2ME	Java 2 Micro Edition
JRPG	Japanese Role-Playing Game
KB	Kilobyte
KeSPA	Korean e-Sports Association
kHz	Kilohertz
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LGBT	Lesbian, Gay, Bisexual, Transgender
LPCM	Linear Pulse Code Modulation
LTE	Long-Term Evolution
M	ESRB: Mature
MACS	Multipurpose Arcade Combat Simulator
MB	Megabyte
MFLOPS	Megaflops
MHz	Megahertz
MIDI	Musical Instrument Digital Interface
MIPS	Millions of Ops per Second
MLG	Major League Gaming Inc.
MMC	MultiMediaCard
MMO	Massively Multiplayer Online
MMORPG	Massively Multiplayer Online Role-Playing Game
MMOW	Massively Multiplayer Online World
MMS	Multimedia Messaging Service
MOBA	Multiplayer Online Battle Arena
MOGA	Mobile Gaming Controller
mono	Monaural
MOS [Technologies]	Metal Oxide Semiconductor
MRI	Motion Reality Inc.
MS	Microsoft
MUD	Multi-User Dungeon
MVS	Multi Video System
N64	Nintendo 64
Namco	Nakamura Manufacturing Company
NAOMI	New Arcade Operation Machine Idea
NEC	Nippon Electric Company
NES	Nintendo Entertainment System

NFC	Near-Field Communication
NIS	Nippon Ichi Software
NPC	Non-playable character
NPD	National Purchase Diary
NTSA	National Training Simulation and Association
NTSC	National Television Standards Committee
NXE	New Xbox Experience
OLED	Organic Light-Emitting Diode
OOE	Out of Order Execution
OS	Operating System
OTS	Over-the-Shoulder
P2W	Pay-to-Win
PAL	Phase Alternate Line
PAX Prime	Penny Arcade Expo
PC/AT	Personal Computer/Advanced Technology
PCI	Peripheral Component Interconnect
PCM	Pulse-Code Modulation
PDA	Personal Digital Assistant
PDP	Plasma Display Panel
PDP-1	Programmed Data Processor-1
PET	Personal Electronic Transactor
PFLOPS	Petaflops
PiP	Picture-in Picture
PNAS	Proceedings of the National Academy of Sciences
POKEY	Pot Keyboard Integrated Circuit
PPS	Polygons Per Second
PS2	PlayStation 2
PS3	PlayStation 3
PS4	PlayStation 4
PSN	PlayStation Network
PSP	PlayStation Portable
PSX	PlayStation
PTSD	Post-Traumatic Stress Disorder
QA	Quality Assurance
RAM	Random Access Memory
RAND or R&D	Research and Development
RCA	Radio Corporation of America
RCP	Reality coprocessor
RDRAM	Rambus Dynamic Random Access Memory
RF	Radio Frequency
RGB	Red, Green, Blue
RISC	Reduced Instruction Set Computer
R.O.B.	Robot Operating Buddy
ROE	Rules of Engagement
ROM	Read Only Memory
RP	ESRB: Rating Pending
RPG	Role Playing Game
RRoD	Red Ring of Death
RTS	Real-Time Strategy
RTT	Real-Time Tactics
SAFE	Strategy and Force Evaluation
SCART	Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs
SCE	Sony Computer Entertainment
SD	Secure Digital
SDT	Self Determination Theory
SECAM	Séquentiel Couleur À Mémoire
SECTER	Simulated Environment for Counseling, Training, Evaluation and Rehabilitation
SEGA	Service Games
SFC	Super Famicom
SGI	Silicon Graphics, Inc.
SHMUP	Shoot'em Up
S-3D	Stereoscopic
Si	International System of Units
SID	Sound Interface Device
SMS	Sega Master System
SNES	Super Nintendo Entertainment System
SNK	Shin Nihon Kikaku
SOE	Soap Opera Effect
S/PDIF	Sony/Philips Digital Interface Format
SRAM	Static Random-Access Memory
SSH	Society for Simulation in Healthcare
STEM	Science, Technology, Engineering and Mathematics
SVP	Sega Virtua Processor
T	ESRB: Teen
TB	Terabyte
TES	Tactical Engagement Simulation
TFLOPS	Teraflops
TG-16	TurboGrafx-16
TGS	Tokyo Game Show
THQ	Toy Headquarters
THz	Terahertz
TIA	Television Interface Adaptor
TLCTS	Tactical Language & Culture Training System
TRADOC	Army Training Doctrine and Command
TRS	Tip, Ring, Sleeve
TRST	TrustCo Bank

TV	Television
UI	User Interface
UMD	Universal Media Disc
USB	Universal Serial Bus
USMC	United States Marine Corps
VBS	Virtual Battlespace
VCD	Video Compact Disc
VCR	Video Cassette Recorder
VCS	Video Computer System
VGA	Video Graphics Array
VGL	Video Games Live
VMU	Visual Memory Unit
VPD	Video Display Processor
VPU	Vector Processing Unit
VR	Virtual Reality
VRAM	Video RAM
VRT	Virtual Reality Therapy
VRU	Voice Recognition Unit
WAN	Wide Area Network
WAP	Wireless Application Protocol
WCG	World Cyber Games
WoW	World of Warcraft
XBL	Xbox Live
XMB	XrossMediaBar
YLOD	Yellow Light of Death

Acknowledgments

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To all who provided permissions and information pertaining to the figures and tables in this book; to all the key game developers, publishers, and other video game talent who have made contributions to the video game business; and to all video game enthusiasts for supporting video games and helping this industry become one of the leading forms of entertainment today.

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Author

Dr. Brian J. Wardyga has been playing video games since he was a child in the early 1980s, beginning with the Atari VCS. Since that time, he has collected games for almost every major console, living through most of what has been written in this book. An expert on the subject that is both his passion and hobby, Brian wrote and designed this textbook to promote student learning in a visual style that encourages reading and provides vivid examples of each major console, its controllers and accessories, along with examples of the print advertisements, game graphics, and box art that was pertinent to each generation of video games.

Brian began teaching at the college level in 2002 at Boston University and has also taught communication and production courses at Curry College, Fisher College, and University of Massachusetts, Boston. He has been a full-time instructor at Lasell College since 2004 where he began teaching courses on video games in 2009. His array of courses taught includes Advanced Radio Production (II), Advanced Television Production, Advanced Video Production (II), Communication Research (graduate level), Digital Video Editing, Effective Speaking, Fundamentals of Communication, Interactive Broadband Television, Media Literacy, Oral Communication, Public Speaking, Radio Production, Television Studio Production, Understanding Mass Media, Understanding Video Games, Video Games & Culture, Video Production (graduate and undergraduate), and Writing for the Media.

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He also worked for 10 collective years in TV production as a Stage Manager and Computer Graphics Technician at WCVB-TV ABC5 for programs such as *Chronicle*, *City Line*, *Commitment 20XX*, *The Evening News*, *Eye Opener News*, *Jerry Lewis Telethon*, *Midday News*, *Patriots Pregame Show*, *Patriots 5th Quarter*, and *the PGA Tour.* Prior to WCVB, Brian worked as an Associate Director for WLVI-TV WB56 on programs such as *Keller At Large*, *New England Stories*, *Patriots SportZone Kickoff*, *The Sports Zone*, and *The Ten O'Clock News.* He also served as a Post Production Assistant at WGBH PBS2 on the *Building Big* documentary series. Brian is also the founding General Manager of 102.9FM WLAS – Lasell College Radio.

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Introduction

Welcome to *The Video Games Textbook*! I appreciate your interest in the text and hope that the following chapters teach you all you ever wanted to know and more about video games and the many platforms they've appeared on. My goal for *The Video Games Textbook* was to facilitate learning the history, business, and technology of video games with visually stimulating, comprehensive, and chronological chapters that are relevant and easy to understand for a variety of readers. This book was structured to be a primary textbook for courses on the history, technology, and/or business of video games.

There are two main types of chapters in this textbook: (1) "platform chapters," which cover the major platforms from each generation of home video game consoles, as well as PC and mobile gaming; and (2) "special topics" chapters that focus on pertinent aspects of video games such as the technology; video game business; sex, violence, gender, and race; and the use of video games in the military, science, and educational communities. Chapters begin with a clear list of objectives, key terms, and timelines of major releases.

Each console-based "platform" chapter reviews the arcade industry for its respective era, which for many generations served as a major influence on the home systems that followed. Consoles are then discussed in detail on their history, key personnel, marketing strategy, technical specifications, breakthroughs and trends, accessories, and important games. Console comparisons are also made between competing systems, including "Head-to-Head" recommendations in comparing game titles across platforms. Console sections conclude with a review of key games and box art to five of the best titles on each system.

Images and tables are provided for a deeper immersion into the subject matter. Tables highlight each system's launch titles, tech specs, and other information, while images of each console, its controller, advertisement(s), and screenshots of games bring the reader closer to fully understanding each game system. "Pro File" sections with a picture and achievement summary of important industry figures highlight the most influential people in the business, and "Did You Know" sections provide additional historical trivia whenever possible. Each chapter concludes with a summary, activity, and chapter quiz to further the learning experience.

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The First Video Games

OBJECTIVES

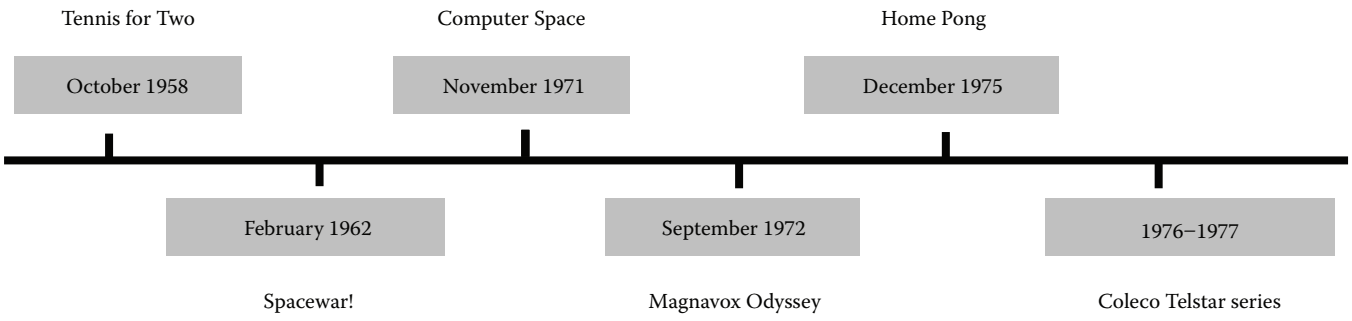
After reading this chapter, you should be able to:

- Describe the types of games found in arcades before video games.
- Discuss the first video games and how they evolved.
- Provide details on video game pioneers such as Ralph Baer and Nolan Bushnell.
- Summarize a brief overview of the history of Magnavox, Atari, and Coleco.
- Describe the Magnavox Odyssey, home Pong system, and Coleco Telstar series.
- Be familiar with the technological differences among first generation systems.
- Review the history of *Pong* and how it helped pave the way for the home market.
- Have a sense of the graphics quality and general capabilities of first generation video game consoles.
- Discuss how the first video games were received by the public.
- Be familiar with the Nintendo Color TV-Game series.
- List the important innovations brought to gaming during this time period.
- Summarize first-generation market sales and trends.

■ KEY TERMS AND PEOPLE

AC adapter
Al Alcorn
Ampex
Andy Capp's Tavern
Atari
AY-3-8500
Ralph Baer
Baffle Ball
Bagatelle
Bertie the Brain
Brookhaven National Laboratory
Brown Box
Bob Brown
Nolan Bushnell
Cartridge slot
Cathode ray tube
Circuit boards
Coleco
Coleco Telstar
Color TV-Game
Combat!
Computer Space
Conn. Leather Co.
Control boxes
Copyright infringement
Copyrights
Ted Dabney
Dedicated Console/ Hardware
Digital displays
Robert Dvorak
EDSAC
Dan Edwards
Electrotennis/Epoch
English control
Flipper bumpers
Game cards
Bill Gattis
General Electric
General Instrument
Martin Graetz
Arnold Greenberg
Maurice Greenberg
David Gottlieb
Bill Harrison
William Higinbotham
Josh Hochberg
Interchangeable games
Peter Jensen
Joysticks
Steve Kordek
Alan Kotok
Harold Lee
Light gun
Gene Lipkin
Magnavox
Nimrod
Nutting Associates
Odyssey
Odyssey follow-ups
Oscilloscope
OXO/Noughts and Crosses
Patents
Pay-outs
PDP-1 computer
Philips
Pinball
Plastic overlays
Pong
Pong for Your Home TV
Edwin Pridham
Prototype
Reset button
RF switchbox
Royalties
Bill Rusch
Steve "Slug" Rusell
Pete Sampson
Sanders Associates
Robert Saunders
Scoring reels
Shooting Gallery
Spacewar!
Super Pong
Sync generator
Syzygy Engineering
Tech Model Railroad Club
Tele-Games
Telstar follow-ups
Tennis for Two
Tilt Mechanism
Tom Quinn
Video Game
Harry Williams

■ FIRST GENERATION TIMELINE



■ THE BEGINNING

Before video games, the arcade business consisted mostly of **pinball** and other mechanical games. The earliest roots of pinball "can be traced back to ***Bagatelle***, a form of billiards in which players used a cue to shoot balls up a sloped table. The goal of the game was to get the balls into one of nine cups placed along the face of the table" (Kent, 2001, p. 2). More than a century later came **David Gottlieb**'s coin-operated ***Baffle Ball*** in 1931 as seen in Figure 1.1. Players inserted a penny for a handful of balls which they would launch with a plunger. They would then bump the table in an attempt to land each ball in a number of pockets. The technique of bumping the table would later become known as "tilting." In 1932 **Harry Williams** advanced the game further by installing "**tilt mechanisms**" which limited the amount of tilting players could use by penalizing them for overdoing it.

Eventually other versions of the game were released such as "**pay-outs**" that combined pinball with elements of gambling. When politicians caught wind of these devices, pinball games of all kinds were outlawed in the United States—with bans lasting nearly 35 years in major areas such as New York (Kent, 2001, pp. 5–6). It wasn't until years later that Gottlieb introduced a new mechanic that would revolutionize pinball forever—**flipper bumpers**. Flipper bumpers (later just called "flippers") first appeared in Gottlieb's *Humpty Dumpty* pinball game in 1947. Besides adding more control of the ball, flippers made pinball into a legitimate game of skill (and less like gambling). **Steve Kordek** further revolutionized the game by placing two flippers at the bottom of the table which were controlled by buttons on the sides. Advancements such as **electromechanical relays** and **scoring reels** paved the way for pinball in the 1950s and 1960s, followed by **circuit boards** and **digital displays** in the 1970s—the decade when video games first appeared on the arcade scene.

DID YOU KNOW?

Josh Hochberg is credited with opening one of the world's first restaurant/arcades with Philadelphia's *Cavalier* in 1961 (Kent, 2001, p. 14). Back then arcades consisted mostly of pinball and other electromechanical games—not video games.

FIGURE 1.1 Evolution of pinball: (a) *Bagatelle*, (b) *Baffle Ball* (1931), and (c) *Rapid Transit* (1935).

(a) (b) (c)

■ THE FIRST INTERACTIVE COMPUTER GAMES

The earliest interactive computer games premiered in the 1950s on huge, wall-size computers such as Dr. Josef Kates's ***Bertie the Brain*** (1950, Toronto) and Dr. John Bennett and Raymond Stuart-Williams's ***Nimrod*** (1951, UK). These games were developed out of academic research labs and played games such as tic-tac-toe, using light bulbs rather than actual monitors with graphics. Dr. Alexander Douglas's ***OXO*** or ***Noughts and Crosses*** (1952, UK) was a non-animated version of tic-tac-toe displayed on a **cathode ray tube (CRT)** monitor for the **Electronic Delay Storage Automatic Calculator (EDSAC)** computer. Each of these games provided a level of interactivity with a computer, but it was the additional element of moving graphics that led to what is widely considered a true **video game**.

■ TENNIS FOR TWO

American nuclear physicist William "Willy" Higinbotham is most often credited with designing the first video game at the Brookhaven National Laboratory. *Tennis for Two* (Figure 1.2) premiered on October 18, 1958 at one of BNL's public exhibitions. Built by Higinotham and Robert Dvorak, the game displayed on a small, 5-inch oscilloscope (round, monochrome display) and was played with two custom aluminum controllers. *Tennis for Two* was improved in 1959 with a larger (10–17 inch) screen in addition to several variations of the game, including "tennis on the moon, with low gravity, or on Jupiter, with high gravity" (Brookhaven National Laboratory, 2016, para. 10).

FIGURE 1.2 *Tennis for Two* (1958) displayed on a DuMont Lab Oscilloscope Type 304-A.

■ SPACEWAR!

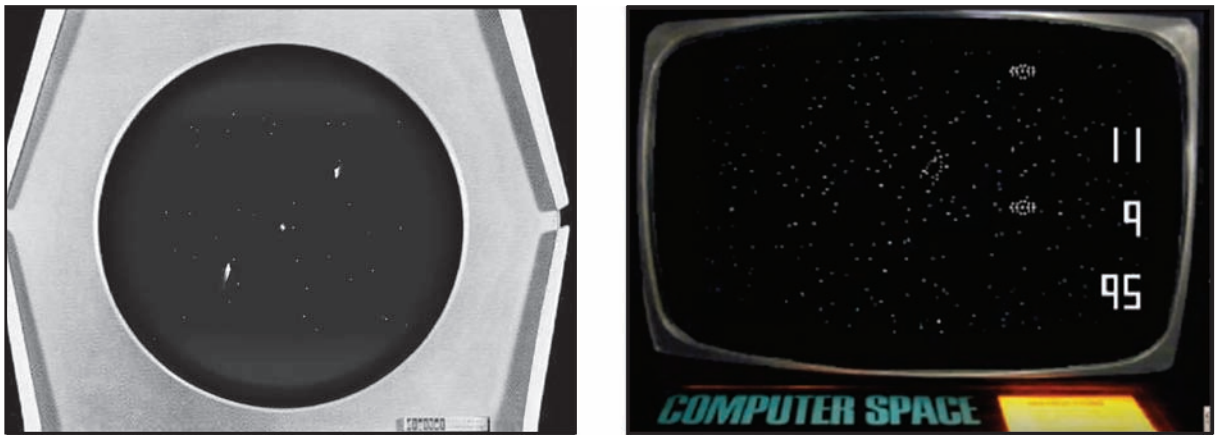
While attending the Massachusetts Institute of Technology (MIT), **Steve "Slug" Russell** began work on an interactive space combat game with the help of some of his peers, collectively known as the **Tech Model Railroad Club**. After months of developing the game for the **Programmed Data Processor-1 (PDP-1)** computer, the final version of ***Spacewar!*** (Figure 1.3a) was completed in the spring of 1962. Russell was the main developer for the game which originally featured four switches: (1) rotate the spaceship clockwise, (2) rotate counterclockwise, (3) rocket thrust, and (4) fire torpedoes. To make the game easier to play, **Alan Kotok** and **Robert Saunders** designed separate **"control boxes,"** which could be considered the world's first wired video game controllers.

Colleague **Pete Sampson** contributed additional programming to display stars in the background and **Dan Edwards** added the "influence of gravity on the spaceships" (Russell, 2001, p. 19). **Martin Graetz** helped complete the game with his "hyperspace" function which would cause the player's ship to disappear and reappear in desperate situations (Graetz, 1981). *Spacewar!* appeared in a handful of educational institutions such as Stanford University and the University of Utah and is therefore credited as the first known video game to be played in multiple locations.

■ COMPUTER SPACE

One University of Utah undergraduate who became a big fan of *Spacewar!* was **Nolan Bushnell**. Bushnell earned part of his tuition money working for Lagoon Amusement Park in Salt Lake City, soliciting quarter games on the midway. He soon worked his way up to maintaining machines in the pinball and electromechanical game arcade (Kent, 2001, p. 29). His work experience and college education led Bushnell to create a coin-operated version of *Spacewar!* called ***Computer Space*** (Figure 1.3b) with colleague **Ted Dabney**. Released under their company name **Syzygy Engineering** in 1971, players piloted a rocket ship in a space battle with a pair of computer-controlled flying

FIGURE 1.3 Screenshots of (a) *Spacewar!* (Steve Russell, 1962) and (b) *Computer Space* (Nolan Bushnell, 1971).



(a) (b)

saucers. The game featured four buttons including: fire missile, thrust, rotate left, and rotate right.

Since Steve Russell never applied for any **copyrights** or **patents** for his game, *Computer Space* never faced any legal trouble for its similarities to *Spacewar!* and coin-op manufacturer **Nutting Associates** built 1500 machines (Edwards, 2011, p. 3). While it may have been too complex for the average consumer, *Computer Space* is renowned for being the first arcade video game and the first commercially distributed video game.

■ MAGNAVOX ODYSSEY

The concept for a home video game console was first envisioned by electronics engineer **Ralph Baer**. After more than a decade of working with **Sanders Associates** on military projects, Baer was given the green light to begin tinkering with his idea in 1967. With the help of **Bill Harrison** and **Bill Rusch**, Baer worked on **prototypes** (early test models) for many years before pitching the seventh iteration to manufacturers. It was called the "**Brown Box**," because of "the amount of adhesive tape holding it together, but its crude design didn't stop it from causing a stir among the major television manufacturers of the late 1960s" (Langshaw, 2014, para. 6).

The console was shown to several companies before being picked up by electronics manufacturer **Magnavox** in January of 1971. Magnavox was formed in 1917 by **Edwin Pridham** and moving-coil loudspeaker inventor **Peter Jensen**. The company specialized in manufacturing radios, TVs, record players, and other devices (such as the first plasma panel) for the U.S. military. A year after securing the deal with Ralph Baer, Magnavox also became the manufacturer of the world's first home video game system.

FIGURE 1.4 Magnavox Odyssey, the first commercial home video game console.

The newly designed **Odyssey** (Figure 1.4) debuted in the United States in September 1972 for $99.95. It included 12 games on six different **game cards**, two controllers, a **radio frequency (RF) switchbox**/cable to connect it to a TV, game accessories, an instruction manual, and six "C" batteries to power the system, shown in Figure 1.5. An optional **AC adapter** could be purchased to operate the unit on electricity. Graphic capability was limited to a few white squares and a vertical line on a black background, so games included **plastic overlays** that would cling to the TV screen (via static electricity) to give each game a unique look and playfield.

The controllers contained flat bottoms that were best suited for placement on a surface such as a coffee table. Each controller had three knobs, including one on the right side and the two on the left side—consisting of a small knob extending from a larger knob. The right knob allowed the player to move the screen dot vertically, the left knob moved the dot horizontally, and the smaller knob allowed the player to exert a small amount of "**English control**" over the console-controlled dot (such as curving the ping pong ball in *Table Tennis*).

On the top of the controller was a single **"reset" button**. Unlike the modern interpretation of a reset function, the Odyssey's reset button did not actually reset the games. Instead, it served as a function for resetting particular game *functions*, such as refreshing the placement of the game dot(s). Beyond the controllers, "two additional controls are present on the main unit: a dial to adjust the position of the center line on the screen and a dial to set the speed of the machine-controlled dot" (Smith, 2015, para. 22). Even if the controllers have long since evolved since the Odyssey, its options to adjust screen position and other game settings are still seen on modern consoles today.

■ UNDERSTANDING ODYSSEY GAMES

A total of 28 games were made for the Magnavox Odyssey, appearing on 11 different game cards. Six game cards containing 12 games were bundled with the console as listed by card number in Table 1.1. The console was also manufactured for the European and Japanese markets with different game bundles. Individual games cost around $6.00 and included screen overlays and game instructions. Game cards with multiple titles played similarly, but provided different instructions to the player which would superficially vary the gameplay.

TABLE 1.1 Magnavox Odyssey U.S. Launch Titles

1. Table Tennis
2. Ski (Figure 1.6a) & Simon Says
3. Tennis, Analogic, Hockey, & Football Part 1 (for passing and kicking)
4. Cat and Mouse, Football Part 2 (for running), Haunted House
5. Submarine (Figure 1.6b)
6. Roulette, States

The game cards were not traditional software like games for modern consoles, but rather printed **circuit boards** that plugged into the console (Table 1.2). The game cards modified the internal circuitry which directed the console to display different components or react to inputs differently. In other words, "there was no memory or game code on these cards, which merely complete[d] different circuit paths within the hardware itself to define the rule set for the current game. All of the game information was contained in the **dedicated hardware**, and inserting a new circuit card was really no different an act from flicking a toggle switch" (Smith, 2015, para. 18).

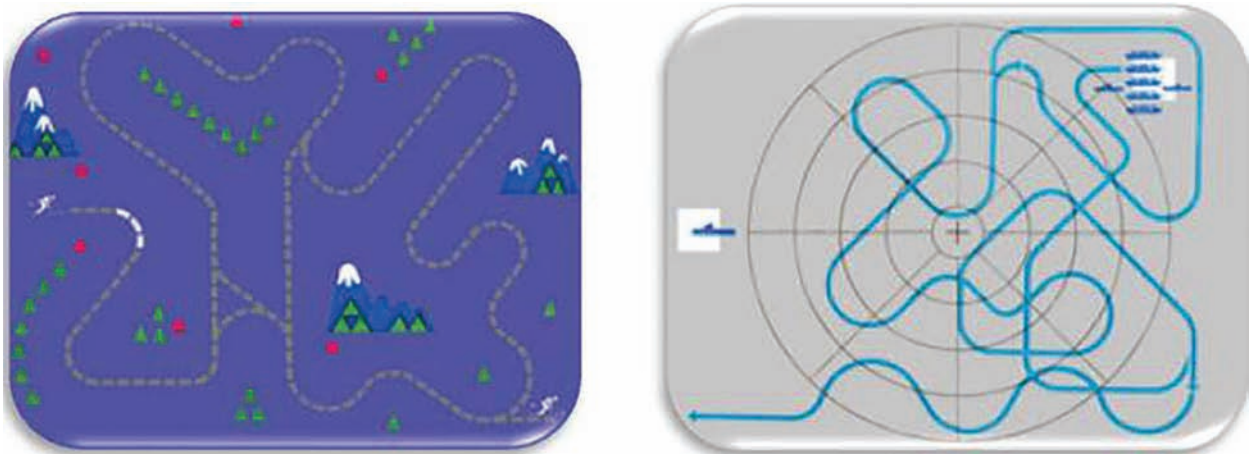
The Odyssey did not have any sound capability, so all the games were silent. The system also lacked a

TABLE 1.2 Magnavox Odyssey Tech Specs

Manufacturer:	Magnavox
Launch price:	$99.95
Release date:	September 1972 (US), 1973 (EU)
Format:	"Game Cards" composed of printed circuit boards
CPU:	None (40 transistors and diodes)
Memory:	None
Resolution:	Not applicable
Colors:	2 (black and white)
Sound:	None

FIGURE 1.5 Magazine advertisement for the Magnavox Odyssey in 1973.

FIGURE 1.6 Screenshots of Odyssey launch titles (a) *Ski* & (b) *Submarine* with plastic overlays.



(a) (b)

microprocessor, so it could not keep a score or understand game logic. All scorekeeping and game rules had to be tracked separately by the players—often requiring a nearby notepad and pencil. The system also included a deck of cards, play money, and a pair of dice for games like *Football, Baseball*, and *Brain Wave.* As primitive as the system was, it did feature an optional light gun accessory called ***Shooting Gallery***. For a handful of games, players could shoot an electronic rifle at the screen to hit a dot of light that moved around under overlays of various cutouts.

Some of the key titles for the Odyssey included *Roulette*, which used an overlay of a roulette wheel and a game board for placing bets with play money and colored chips. *Ski* "required the player to use the dials on the Odyssey controller to follow trails set out on the screen overlay. If you managed to complete a trail without veering too far off, you awarded yourself points" (IGN, 2007, p. 2). Perhaps the most complicated game was *Football*, which required two game cards. Card one was programmed for passing and kicking, while card two was programmed for running. In addition to switching the game cards regularly, players also needed to use a game board, scoreboard, and six decks of playing cards containing various football plays. *Haunted House* (overlay shown in Figure 1.7) was a chase game where player one's dot assumed the role of a detective trying to collect clue cards without being caught by the second player's dot who was a ghost. It was a lot like a board game on TV.

Magnavox was acquired by Dutch electronics company **Philips** in 1974, which released versions of the

FIGURE 1.7 Plastic screen overlays for Odyssey titles *Haunted House* and *Roulette.*

PRO FILE

KEY FACTS:

Developed the first home video game console, the Magnavox Odyssey.

Known as "The Father of Video Games"

RALPH BAER

PRO FILE

HISTORY:

- Born: March 8, 1922, Rodalben, Germany
- Died: December 6, 2014, Manchester, NH

EDUCATION:

- Graduated from National Radio Institute as radio service technician in 1940
- BS in Television Engineering from American Television Institute of Technology in 1949

CAREER HIGHLIGHTS:

- Served in US Army Military Intelligence in WWII
- Worked for Sanders Associates from 1956 to 1987
- Developed the first multiplayer, multiprogram video game system the 'Brown Box' from 1967 to 1969
- Sanders licensed the system to Magnavox in 1972
- Developed programmable, RC RecordChangers as well as SIMON, MANIAC, and Computer Perfection

RECOGNITION:

- Awarded the National Medal of Technology in 2004 for inventing the first video game console

TABLE 1.3 Magnavox Odyssey Series Releases

Unit Name	Year	Description
Odyssey 100	1975	Used four Texas Instruments chips; played *Tennis* and *Hockey;* used AC adapter or 6 "C" batteries
Odyssey 200	1975	Used TI single-chip; played *Tennis* and *Hockey* and added a third game called *Smash*; added a scoring system; was the first video game console with 2-player or 4-player options
Odyssey 300	1976	Used AY-3-8500 chip; simplified to single knobs; same game as Odyssey 200; added three difficulty levels (Novice, Intermediate and Expert) and on-screen numerical scoring system
Odyssey 400	1976	Same games as Odyssey 300 with the addition of an automatic serving system; three-knob controls returned; added extra Texas Instruments chip to display digital on-screen scoring
Odyssey 500	1976	Paddle graphics were changed into simple human figures (i.e., tennis and hockey players); included a fourth *Soccer* game which was essentially hockey using squash figures
Odyssey 2000	1977	Added a practice mode of one-player *Squah* (aka *Smash*); was programmed to end after a player reached 15 points; returned to single-knob controls found on Odyssey 300
Odyssey 3000	1977	Added *Basketball, Soccer,* and *Gridball,* also contained *Smash* and *Basketball* practice modes; added a handcap switch as well as serve, ball speed, and ball deflection options
Odyssey 4000	1977	Used AY-3-8615 (color) chip; Played *Tennis, Hockey, Volleyball, Basketball, Knockout, Tank,* and *Helicopter*; 24 total selectable game modes; included a pause button detachable joysticks

Odyssey in Europe. After the acquisition, a total of eight subsequent versions of the Magnavox Odyssey were released in the United States between 1975 and 1977, as illustrated in Table 1.3. These were all **dedicated consoles** which only contained built-in games.

■ PONG

Following *Computer Space*, Bushnell and Dabney formed a new company—**Atari**. Bushnell adopted the word "Atari" from the Japanese strategy game *Go*. The term basically means "to hit the target" and is similar to the term "check" in the classic game of *Chess*. Atari's focus remained on the arcade market where the manufacturing side of the amusement machine business consisted of around only five important game manufacturers, a handful of pool table manufacturers, and maybe four major jukebox manufacturers (Adlum, 2001, p. 37). That landscape would begin to change in 1972—the year Atari became incorporated and hired former **Ampex** employee **Al Alcorn** to create the company's next game, ***Pong***.

To convince Alcorn to develop the game, Bushnell fabricated a story that he had a contract with **General Electric** to design an electronic version of ping pong. The game was supposed to be a practice project to help familiarize Alcorn with the process of what would be his first experience in making a video game (Shea, 2008, p. 1). The concept was extremely similar to *Table Tennis* on the Magnavox Odyssey, which hadn't been released yet—however Bushnell had played it earlier that year at a trade show in Burlingame, CA.

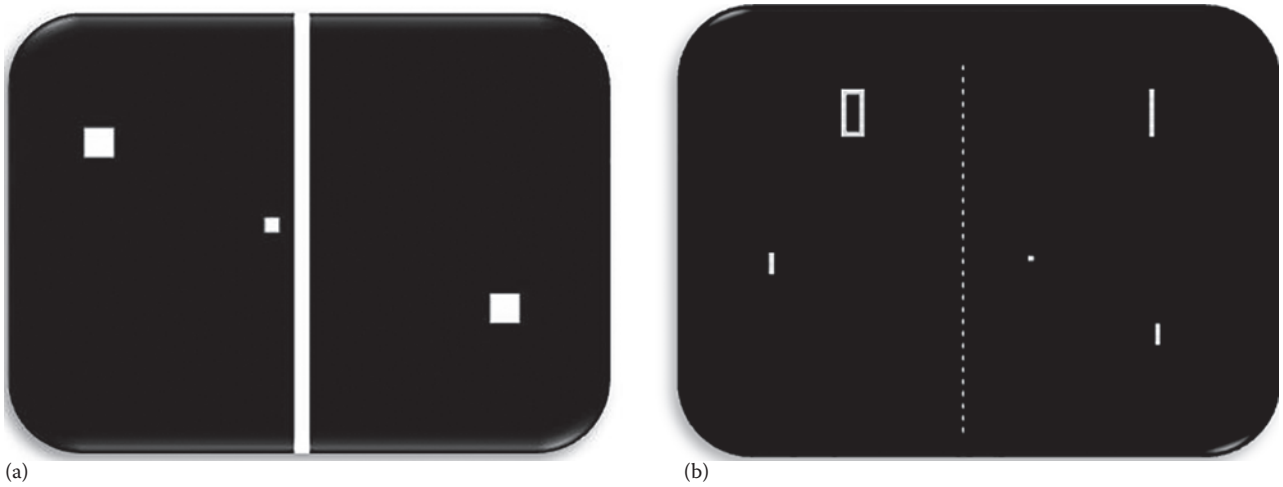
Alcorn went above and beyond Bushnell's vision, using less expensive parts, adding deflection angles to the ball when it hit one of eight sections of the paddles, and enhancing the game with ball acceleration. This feature made the game more challenging, where "after the ball had been hit a certain number of times, it would automatically fly faster" (Kent, 2001, p. 41). He even tinkered with the **sync generator** where he found sound effects he could use that were already inside the machine.

Bushnell and Alcorn installed a Pong prototype at a local bar in Sunnyvale, CA called **Andy Capp's Tavern** in September 1972. A couple of weeks later, Alcorn received a call from tavern manager **Bill Gattis** who claimed the machine had stopped working. When Alcorn arrived to fix it, he discovered the problem was that the machine was overflowing with quarters (Kent, 2001, pp. 43–45). It was clear that Pong was a success and the game was announced for mass production on November 29, 1972.

Atari did not have a lot of money in the beginning, so Bushnell and Dabney hired anyone they could find to assemble the *Pong* cabinets (see Figure 1.8).

FIGURE 1.8 Vendor print advertisement for *Pong* (1972).

FIGURE 1.9 Screenshot comparison: Odyssey *Table Tennis* (a) versus *Pong* (b).



(a) (b)

From unemployment office leads to motorcycle gangs, Atari's choice of employees brought along drug abuse and theft. According to Bushnell (2001), "there was about a six-week period [when employee theft was rampant]" … "We fired a lot of people, and there was still a lot of marijuana use" (p. 52). While initial manufacturing was slow, *Pong* would become one of the first video games to reach mainstream popularity. It grew into an international success in 1973 and a home version of the game was proposed a year later.

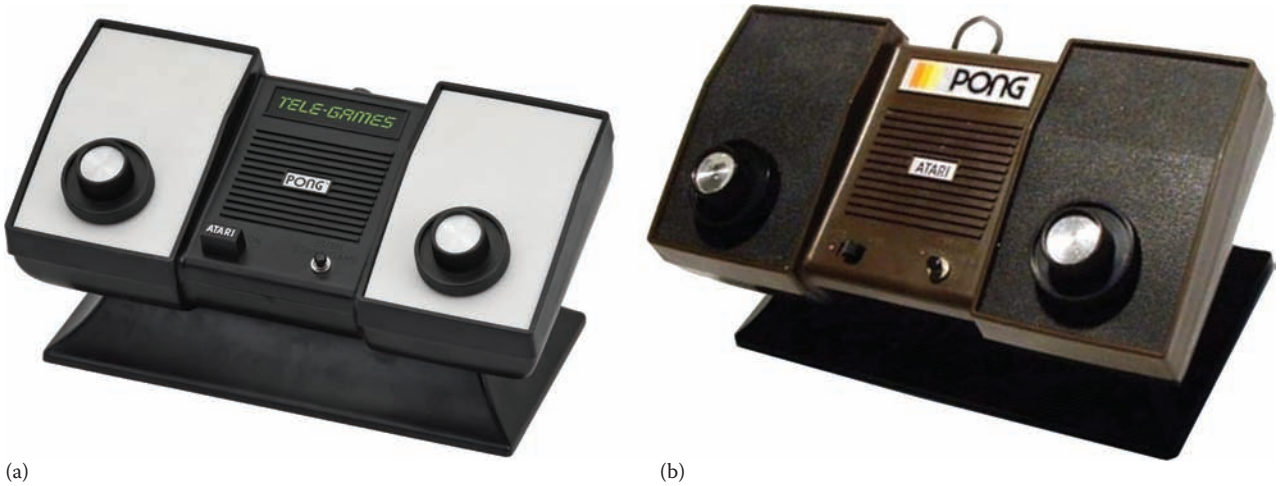
Pong's success did not come without a price, however. It was much too similar to *Table Tennis* on Magnavox Odyssey as seen in Figure 1.9. Unlike Steve Russell, who never applied for copyrights or patents on *Spacewar!*, Ralph Baer was meticulous with his recordkeeping and filed numerous patents for his work. "When Atari's *Pong* debuted just months after the Odyssey went to market, Sanders and Magnavox sued them for **copyright infringement**. The case was settled for $700,000 and Atari became an Odyssey licensee" (Mullis, 2014, para. 6). In the end, the deal turned out to be a win-win for both companies. Atari became a licensee for a relatively small amount of money and other companies producing similar ping pong video games would have to pay **royalties** (compensation for the use of copyrighted or patented works). Magnavox also made out from *Pong*'s success, which helped boost sales of its Odyssey consoles.

■ PONG FOR YOUR HOME TV

Designed by Al Alcorn, **Harold Lee,** and **Bob Brown**, a prototype for the home version of *Pong* was completed in 1974. "With the price of digital circuits constantly dropping, Atari's digital home console ended up costing far less to manufacture than Odyssey" (Kent, 2001, p. 80). Atari had some difficulty finding a retailer for the product until VP of Sales **Gene Lipkin** saw an advertisement in a Sears catalog for the Magnavox Odyssey in the sporting goods section. Sears' **Tom Quinn** helped seal the deal with Sears, Roebuck & Company to distribute the system under the Sears "**Tele-Games**" label (Winter, 2013, para. 2). The *Pong* console (Figure 1.10) was released for the holidays in December 1975 for $98.95. See Figure 1.11 for the print advertisement.

Pong's controls were much simpler than *Table Tennis* on the Odyssey. In *Pong*, players had one dial that moved the paddles up and down. The Odyssey featured three dials for moving its square paddles up and down, toward and away from the net, in addition to applying

FIGURE 1.10 The Sears *Tele-Games Pong* (1975) (a) and Atari's own *Pong* console (1976) (b).



(a) (b)

user-controlled English on the ball. This may seem advantageous on paper—however, it was *Pong*'s simplicity that made this new medium more accessible to most consumers who were experiencing video games for the first time.

DID YOU KNOW?

Shortly before *Pong* landed in U.S. homes, Japan received its first home video game console when ***Electrotennis*** by **Epoch** released overseas on September 12, 1975. Another ping pong-style game, its paddle movement and ball English were similar to *Table Tennis*, while its graphics and sound more closely resembled *Pong*.

Compared to *Table Tennis*, *Pong* had sharper graphics. The various angles the ball could bounce off the paddles, coupled with the gradual increase in speed, resulted in a more challenging and engaging experience. *Pong* felt more like players were hitting a bouncing ball, whereas the English physics in *Table Tennis* played more like a volleying an unpredictable, cartoonlike object. *Pong*'s inclusion of sound (Table 1.4) also greatly enhanced players' engagement. Sound was only emitted from a built-in speaker in the center of the console, which could not be sent through the television speaker.

TABLE 1.4 Atari Pong Home Console Tech Specs

Manufacturer:	Atari
Launch Price:	$98.95
Release date:	December 1975
Format:	Dedicated console (game built in)
CPU:	None (transistor-transistor logic [TTL] circuits)
Memory:	None
Resolution:	Not applicable
Colors:	2 (black and white)
Sound:	Built in mono speaker

It wasn't the first home console on the market, but the home version of *Pong* was a pivotal success for the early video game industry. Approximately 150,000 *Pong* systems were sold that holiday season through Atari's collaboration with Sears. "Atari released its own branded version of the console [subtitled "***Pong For Your Home TV***"] starting in 1976, just as an explosion of *Pong* clones saturated the home video game market" (Loguidice, 2009, p. 4). Atari released other *Pong* variations, such as *Super Pong*, *Pong Doubles*, and *Ultra Pong*. These versions added multiple game modes and/or up to four-player simultaneous game play. However, the manufacturer to release the most consoles in the late 1970s was a new game company out of Connecticut.

FIGURE 1.11 Sears Christmas catalog advertisement for *Tele-Games Pong* system in 1975.

■ COLECO TELSTAR

Connecticut Leather Company was founded in 1932 by **Maurice Greenberg** and began as a shoe supply store. The company shortened its name to **Coleco** in 1961 and expanded to manufacturing plastic molding and wading pools. The leather business was eventually sold off, and by the end of the 1960s the company became the world's largest manufacturer of above-ground swimming pools (Kleinfield, 1985, para. 21). Under CEO **Arnold Greenberg**, Coleco entered into the video game business in 1976 with the **Coleco Telstar** (Figure 1.12) which debuted at just $49.95. The console was initially delayed after failing FCC interference tests and Coleco hired Ralph Baer to fix the problem (Kent, 2001, pp. 96–97).

The first Telstar system included single control knobs for each player and came bundled with three internal ping pong style games *Tennis, Hockey*, and *Handball*. The center panel of the unit included an on/off switch, toggle switch for *Tennis, Hockey*, and *Handball*, a reset button, and a beginner/intermediate/pro toggle switch to change the difficulty level of the games. Perhaps the biggest innovation for Coleco's entry system was that it was the first to use the **General Instrument AY-3-8500** chip (Table 1.5). The AY-3-8500 was unique in that it could play up to six selectable games, including two rifle shooting games on systems equipped with a light gun. The chip was later adopted by other manufactures such as Magnavox for its remarkably similar **Odyssey 300** system.

TABLE 1.5 Coleco Telstar Tech Specs

Manufacturer:	Coleco
Launch price:	$49.95
Release date:	1976
Format:	Dedicated console (games built in)
CPU:	General instruments AY-3-8500 chip
Memory:	None
Resolution:	Not applicable
Colors:	2 (black and white)
Sound:	Built in mono speaker

Like other first-generation systems, the Telstar operated on six "C" batteries or an optional power adapter. And just like Magnavox, Coleco developed multiple versions of the Telstar—hastily producing 14 different models in just two years. Early models ran on the GI AY-3-8500 chip, such as the Classic, Deluxe, Ranger, and Alpha. The **Telstar Ranger** (1977) was the first Telstar unit to feature a **light gun** and detachable wired paddles. It also added three more games (*Jai Alai, Target*, and *Skeet*), maximizing the AY-3-8500's six game capacity. That same year Coleco released the **Telstar Colormatic**, which allowed up to four on-screen colors with the **Texas Instruments SN76499N** chip.

FIGURE 1.12 The first Coleco Telstar system, model 6040 (1976).

Other Telstar consoles included variations of fixed and detachable controllers, light guns, and updated chips with color graphics. One standout system was **Combat!** (1977) (Figure 1.13a), which was the first Coleco system to include **joysticks**. The system contained four fixed joysticks where up to four players could cram around the unit together to play *Combat, Night Battle, Robot Battle*, and *Camouflage Combat*. Another significant variation released in 1977 was the **Telstar Gemini** which was the first Telstar to not include a *Pong*-style game. The Gemini ran on the **MOS Technology MPS 7600-004** chip and was built to play pinball and light gun games. The console featured red "flipper" buttons on each side of the unit and came with a detachable wired light gun. Perhaps the most unique Telstar system released in 1977 was the **Telstar Arcade** (Figure 1.13b).

DID YOU KNOW?

Coleco Telstar systems were sold *partially assembled*. In other words, the consumer usually had to attach the paddle knobs and apply the decorative stickers onto the console. Coleco may have done this to reduce assembly costs and is the only major console manufacturer known to release systems this way (Winter, 2013, para. 7).

This triangular-shaped console was a three-in-one system, with one side featuring a steering wheel and gear shift section, one side with the *Pong*-like dual paddles setup, and a third side containing a light gun and holster. The Telstar Arcade operated on the same MOS chip as the Gemini; however, this system introduced a triangular **cartridge slot** for **interchangeable games**. Similar to the way the original Odyssey used interchangeable circuit-based games, each cartridge contained "a custom programmed MOS Technology MPS-7600 microcontroller with a mere 512 words of program ROM" (Grahame, 2007, para. 3).

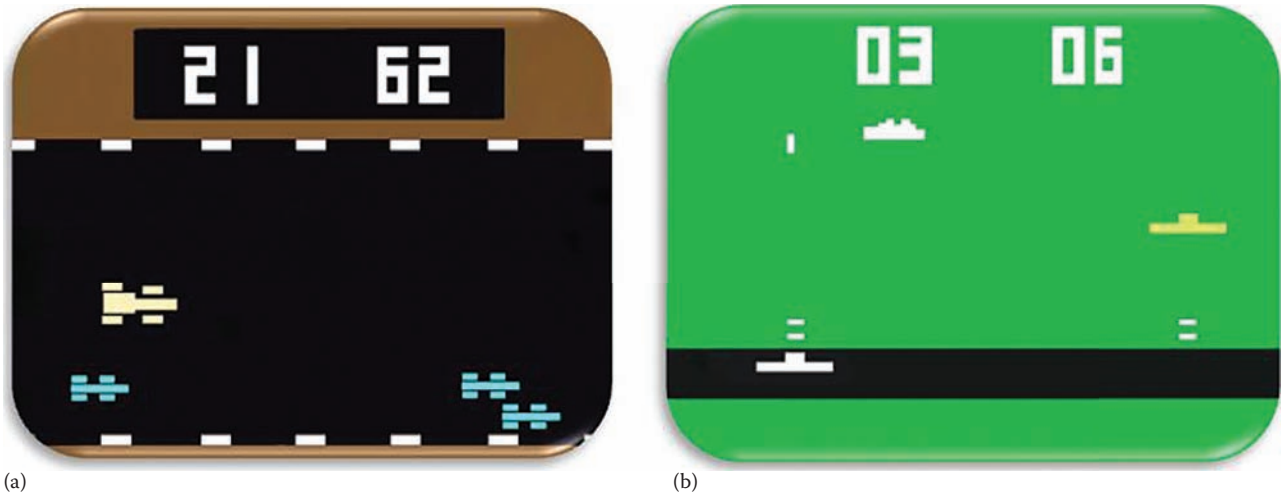
As interesting as it was, only four different cartridges were ever released for the Telstar Arcade—each containing multiple games. Cartridge 1 was the pack-in game for the system with three games: *Road Race* (Figure 1.14a), *Tennis*, and *Quick Draw*. Cartridge 2 came with four games including *Hockey, Tennis, Handball*, and *Target*. The third cartridge included two variations of *Pinball, Shooting Gallery*, and *Shoot the Bear*. The fourth and final cartridge was bundled with three games: *Naval Battle* (Figure 1.14b), *Speed Ball*, and *Blast-Away*. Coleco released 14 different models of the Telstar. See Table 1.6 for the variations which were released after the original.

FIGURE 1.13 Two of the most distinctive Coleco systems: (a) Combat! and (b) Telstar Arcade.

(a)

(b)

FIGURE 1.14 Screenshots of Telstar Arcade games (a) *Road Race* and (b) *Naval Battle.*



(a) (b)

TABLE 1.6 Subsequent Coleco Telstar Series Releases

Unit Name	Year	Description
Classic	1976	Rectangular model of original system with a wood grain case; played *Tennis, Hockey,* and *Handball* on GI AY-3-8500 chip
Deluxe	1977	Same rounded body as original, with a wood grain finish; same three games; manufactured for the Canadian market
Ranger	1977	Silver and black unit; first Telstar with a **light gun** and **detachable wired paddles**; added three games: *Jai Alis, Target,* and *Skeet*
Alpha	1977	Simpler silver and black unit; fixed paddles and no light gun; played four games: *Tennis, Hockey, Handball,* and *Jai Alai*
Colormatic	1977	Brown with wood grain; added **color** with extra **Texas instruments SN76499N** chip; removable paddles; same games as Alpha
Regent	1977	Silver and black unit; basically identical to Alpha but added detachable wired paddles; played same four games
Combat!	1977	First Telstar to include **joysticks**-four of them fixed to the unit; played four games; *Combat, Night Battle, Robot Battle,* and *Camouflage Combat*; used GI AY-3-8700 chip
Galaxy	1977	Used AY-3-8600 games chip and AY-3-8615 for color; included paddle controllers, in addition to detachable wired joysticks
Gemini	1977	First **non-*Pong***-style telstar; played four **pinball** and two gun games; unit had red "flipper" buttons on sides along with detachable gun; ran on MOS Technology MPS 7600-004
Arcade	1977	Triangular-shaped three-in-one system; with **steering wheel** and **shift** section, dual paddles section, and light gun with holster; same color chip as Gemini; four triangular **cartridge games**
Sportsman	1978	Updated silver and black unit; similar to Regent but added light gun; played the same six games as Ranger
Colortron	1978	Brown, compact design; used GI AY-3-8510 chip with color; fixed paddles and four games; *Tennis, Hockey, Handball,* and *Jai Alai*
Marksman	1978	Black with silver and red accents; used GI AY-3-8512 chip; wired gun and fixed paddles; same six games as Sportsman and Ranger. See Figure 1.15 for print advertisement

FIGURE 1.15 Magazine advertisement for the Telstar Marksman (1978).

■ COLOR TV-GAME SERIES

Nintendo also released a series of five, single-game consoles known as the **Color TV-Game** series (Figure 1.16) between 1977 and 1980. See Table 1.7 for descriptions of the different units. While technically released during the second wave of video game consoles, the Color TV-Game units are commonly categorized as first-generation machines because they were all-in-one "dedicated" systems that did not contain interchangeable software. Nintendo estimated to have sold approximately 3 million total Color TV-Game units.

It would be a stretch to compare these sales figures to the other consoles discussed in this chapter, since the Color TV-Games were only released in Japan and were manufactured for many years after the Odyssey, *Pong*, and Telstar systems. The system deserves mention for its success overseas and for being the first home console from Nintendo.

FIGURE 1.16 Nintendo's first home video game console, the Color TV-Game 6.

■ FIRST GENERATION MARKET SUMMARY

The Magnavox Odyssey ultimately sold less units than the home version of *Pong*. It is important to note that the Odyssey was released in 1972 and Atari's *Pong* system was introduced in 1975. Odyssey sales were slow early on because a video game system in the home was a new concept that the general public had not yet become accustomed to. Sales may have also initially suffered by the way the Odyssey was marketed. Because Odyssey "distribution was restricted to the Magnavox network of dealers that sold the company's products exclusively... many consumers may well have been left with the impression that the system only worked on Magnavox TVs when they saw it at retail (Smith, 2015). In 1976, "Magnavox sold 100,000 Odysseys. Atari sold 150,000 Home *Pong* machines in a single season" (Kent, 2001, p. 94). The system became an instant bestseller, earning Atari a **Sears Quality Excellence Award**. Atari would proceed to become the name

TABLE 1.7 Nintendo Color TV Game Series Releases

Unit Name	Released	Description
Color TV-Game 6	06/01/77	*Pong* clone with six versions of *Light Tennis (Tennis, Hockey, Volleyball)*
Color TV-Game 15	06/08/77	Contained 15 variations of *Light Tennis*; sold more than 1 million units
Color TV-Game Racing 112	06/08/78	Racing game with steering wheel and gearshift; Shigeru Miyamoto's first video game assignment
Color TV-Game Block Breaker	04/23/79	*Breakout* clone, aka "*Karā Terebi-Gēmu Burokku Kuzushi*"
Color TV-Game	1979–1980	Pricey port of Nintendo's first arcade video game *Computer Othello*

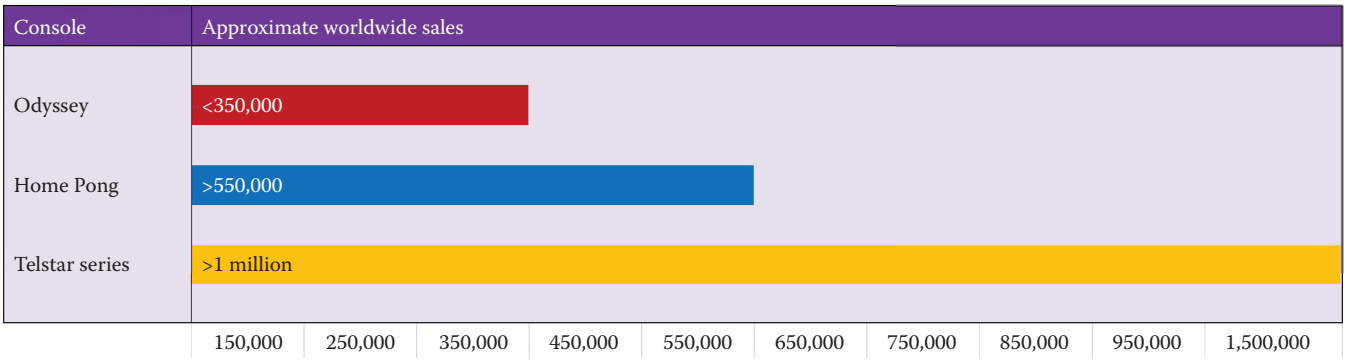
synonymous with video games with its next home console in 1977.

A look at the sales figures for the first generation of consoles in Figure 1.17 shows that Coleco dominated the market with its Telstar series, although these numbers do not tell the whole story. Coleco did dominate the market in 1976 selling "over $100 million worth of the [Telstar] consoles and rose to the top of the consumer game business" (Kent, 2001, p. 98). However, its *financial* success with the Telstar series would only last for about a year.

By 1978, Coleco nearly went bankrupt as the home video game market progressed "to programmable, cartridge based game units. With *Pong*-type game manufacturers slashing the price of their dedicated consoles up to 75%, Coleco [was] forced to dump over a million obsolete Telstar machines at a cost of 22.3 million dollars" (Hunter, 2014, p. 1). Coleco may have sold the highest overall volume of video game systems during the first generation, but low returns and major price drops found Coleco pretty much breaking even with the Telstar series.

As for the pinball industry, it reached a peak of 200,000 machine sales and $2.3 billion revenue in 1979. With electronic video games gaining popularity in the family amusement market, the pinball industry would see a decline to 33,000 machines and a value of approximately $464 million in 1982 (Citron, 1982, p. 13). It was no coincidence that these years would become known as the **Golden Age** of video games in the arcades. Meanwhile, Atari, Coleco, and Magnavox went on to produce cartridge-based game units for a whole new era of video game consoles that would eventually become known as the second generation of video games.

FIGURE 1.17 First-generation console sales graph.



■ FIRST GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the first generation of video games. Here is a list of the top 10 features that defined the generation:

1. Discrete transistor-based digital game logic
2. Dedicated console games were built in, rather than using removable media
3. Light gun peripheral and paddle style, analog controllers
4. All first-generation playfields occupied a single screen
5. Graphics consisted of basic lines, dots, and/or blocks
6. Mostly monochrome (black and white) or other dichromatic combination
7. Color overlays could be attached to the TV screen for faux color
8. Later games as seen on Coleco Telstar systems could display up to four colors
9. Games were limited to single-channel or no sound at all
10. No microprocessor; logic, flip-screen playfields, and sprite-based graphics

■ ACTIVITY: GAMER PROFILE

What are your earliest memories of video games? What kind of gamer are you? How do your gaming habits and interests compare to other students or your friends?

Name: _____ **Online Name:** _____

Gamer Since (Year): _____ **Why study video games?** _____

First Video Game Memory: _____

I consider my interest in video games: Casual | Moderate | Above Average | Obsessed

Weekly game time: 1–5 hours | 6–10 hours | 11–15 hours | 16–20 hours | 20+ hours

Consoles owned (or played a lot) and number of games completed for each:

_____ # _____ _____ # _____
_____ # _____ _____ # _____
_____ # _____ _____ # _____
_____ # _____ _____ # _____

Favorite console of all time and why:

_____

Favorite types of games (circle or check all that apply):

Action	Fighting	Racing	Simulation
Adventure	First-Person Shooter	Role-Playing	Sports
Board Game	Gambling	Rhythm	Strategy
Dance	Puzzle	Shoot 'Em Up	Trivia

Ten favorite games that come to mind:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

■ CHAPTER 1 QUIZ

1. Which of the following was *not* part of the evolution of games that predated video games?
   a. Bagatelle
   b. Baffle Ball
   c. Pinball
   d. Speedball
2. Often credited for developing the first electronic game called *Tennis for Two* in 1958:
   a. Nolan Bushnell
   b. Steve "Slug" Russell
   c. Willy Higinbotham
   d. Ralph Baer

3. What type of monitor was *Tennis for Two* originally displayed on?
   a. CRT television
   b. Oscilloscope
   c. Movie screen
   d. Personal computer monitor

4. MIT student who developed *Spacewar!*:
   a. Nolan Bushnell
   b. Steve "Slug" Russell
   c. Willy Higinbotham
   d. Ralph Baer

5. The "Father of Video Games" whose Brown Box console game system became the Magnavox Odyssey:
   a. Ray Kassar
   b. Ralph Baer
   c. Willy Higinbotham
   d. Steve Russell

6. Which product was *not* developed for the original Magnavox Odyssey system?
   a. Game card
   b. Joystick
   c. Light gun
   d. Plastic overlay

7. These two gentlemen were the original founders of Atari:
   a. Steve Jobs and Steve Wozniak
   b. Ray Kassar and Ted Dabney
   c. Trip Hawkins and Ted Russell
   d. Nolan Bushnell and Ted Dabney

8. What year was the first *Pong* arcade machine produced?
   a. 1960
   b. 1972
   c. 1978
   d. 1987

9. Which of the following was *not* a feature of *Pong* implemented by Al Alorn:
   a. Using less expensive parts
   b. Adding deflection angles to the ball when it hit sections of the paddles
   c. Enhancing the game with ball acceleration
   d. Crowd noises such as applause and boos

10. *Pong* led to Atari being sued by _____ for copyright infringement.
    a. Syzygy Engineering
    b. Sanders Associates and Magnavox
    c. Nutting Associates
    d. Brookhaven National Laboratory

11. Atari's first home version of *Pong* was licensed by retailer _____ under the Tele-Games label.
    a. Sears, Roebuck & Company
    b. K-Mart
    c. J.C. Penney
    d. None of the above

12. Which of the following was *not* a business Coleco had a hand in before video games?
    a. asphalt roofing
    b. leather
    c. plastic molding
    d. swimming pools

13. The first home video game system to use the General Instrument AY-3-8500 chip:
    a. Odyssey
    b. Pong For Your Home TV
    c. Telstar
    d. Color TV Game

14. Subsequent consoles such as Ranger, Combat!, and Gemini were developed by:
    a. Magnavox
    b. Atari
    c. Coleco
    d. Nintendo

15. Which of the following was *not* one of the three sections of the Telstar Arcade?
    a. Joysticks
    b. Paddles
    c. Light gun
    d. Steering wheel and gear shift

16. This company's game systems were sold partially assembled, where the consumer usually had to attach the paddle knobs and apply the decorative stickers onto the console:
    a. Magnavox
    b. Atari
    c. Coleco
    d. Nintendo

17. The first-generation console with removable *cartridges* for different games to be played:
    a. Odyssey
    b. Super Pong
    c. Telstar Gemini
    d. Telstar Arcade

18. Nintendo produced a successful series of single-game home consoles in Japan called:
    a. Game and Watch
    b. Color TV-Game
    c. Game for TV
    d. None of the above

19. Which first-generation U.S. home console series sold the most units overall?
    a. Odyssey
    b. Pong
    c. Super Pong
    d. Telstar

20. Systems with the game(s) built in, rather than using removable media are called:
    a. All-in-one consoles
    b. Dedicated consoles
    c. Solid state consoles
    d. Stand-alone consoles

True or False

21. *Spacewar!* by Nolan Bushnell was the first coin operated arcade video game in 1971.

22. The original Magnavox Odyssey was not capable of producing sound in its games.

23. The sound on the home version of *Pong* was only emitted from a built-in speaker in the center of the console, which could not be sent through the television speaker.

24. The name "Coleco" was derived from the words "California Leather Company."

25. Fourteen different models of the Telstar were manufactured between 1976 and 1978.

■ FIGURES

FIGURE 1.1 Evolution of pinball: (a) *Bagatelle*, (b) *Baffle Ball* (1931), and (c) *Rapid Transit* (1935). (*Bagatelle* photo from Hotel-R. Retrieved from http://www.hotel-r.net/fr/bagatelle; also at http://www.jaqueslondon.co.uk/indoor-games/bagatelle.html. *Baffle Ball* image from Pacific Pinball Museum, 2016, edited by Wardyga. Retrieved from http://pacificpinball.org/articles/baffle-ball. *Rapid Tranist* image from Arcade Museum, photo contributed by Clive Godwin. Retrieved from http://www.arcade-museum.com/game_detail.php?game_id=12189)

FIGURE 1.2 *Tennis for Two* (1958) displayed on a DuMont Lab Oscilloscope Type 304-A. (*Tennis For Two* come appariva nel 1958, by Brookhaven National Laboratory - Screenshot, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=27864450 Retrieved from https://en.wikipedia.org/wiki/Tennis_for_Two#/media/File:Tennis_For_Two_on_a_DuMont_Lab_Oscilloscope_Type_304-A.jpg)

FIGURE 1.3 Screenshots of (a) *Spacewar!* (Steve Russell, 1962) and (b) *Computer Space* (Nolan Bushnell, 1971). (*Spacewar!* and *Computer Space* screenshots by Wardyga.)

FIGURE 1.4 Magnavox Odyssey, the first commercial home video game console. ("The Magnavox Odyssey, the very first video game

console," by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17168362 Retrieved from https://en.wikipedia.org/wiki/Magnavox_Odyssey#/media/File:Magnavox-Odyssey-Console-Set.jpg)

FIGURE 1.5 Magazine advertisement for the Magnavox Odyssey in 1973. (Screenshots of Odyssey launch titles *Ski & Submarine* with plastic overlays "Magnavox Odyssey," by Video Game Console Library. Retrieved from http://www.videogameconsolelibrary.com/pg70-odyssey.htm#page=games)

FIGURE 1.6 Screenshots of Odyssey launch titles (a) *Ski* & (b) *Submarine* with plastic overlays. ("Plastic television overlays," by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=40354387; retrieved from https://en.wikipedia.org/wiki/Magnavox_Odyssey#/media/File:Magnavox-Color-Screen-Overlays.jpg)

FIGURE 1.7 Plastic screen overlays for Odyssey titles *Haunted House* and *Roulette*. (From *The Magnavox High Reliability* magazine, 1973, p. 45. Image scanned and restored by Wardyga. Magazine advertisement for the *Magnavox Odyssey* in 1973.)

FIGURE 1.8 Vendor print advertisement for *Pong* (1972). (*Pong*, Atari, 1973. Advertisement for Pong. Posted by Jesper Juul. Available at https://www.jesperjuul.net/thesis/2-historyofthecomputergame.html. Restored by Wardyga.)

FIGURE 1.9 Screenshot comparison: Odyssey *Table Tennis* (a) versus *Pong* (b). (*Table Tennis* image by Wardyga. *Pong* screenshot: "The two paddles return the ball back and forth," by Bumm13 [2] - originally upload at en.wikipedia.org [1], public domain. Available at https://commons.wikimedia.org/w/index.php?curid=799667. Retrieved from https://en.wikipedia.org/wiki/Pong#/media/File:Pong.png)

FIGURE 1.10 The Sears *Tele-Games Pong* (1975) (a) and Atari's own *Pong* console (1976) (b). (The Sears *Tele-Games Atari Pong* console, released in 1975, by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18298737. Retrieved from https://en.wikipedia.org/wiki/First_generation_of_video_game_consoles#/media/File:TeleGames-Atari-Pong.png. History of Consoles: *Pong*, 1975, posted on June 13, 2012 by Gamester81. Available at http://gamester81.com/history-of-consoles-pong-1975/)

FIGURE 1.11 Sears Christmas catalog advertisement for *Tele-Games Pong* system in 1975. (The Atari Home *Pong* Console Is 40 Years Old, posted August 21, 2015 by Metv Staff. Retrieved from http://www.metv.com/stories/the-atari-home-pong-console-is-40-years-old)

FIGURE 1.12 The first Coleco Telstar system, model 6040 (1976). (Courtesy of Wardyga.)

FIGURE 1.13 Two of the more distinctive Coleco systems: (a) Combat! and (b) Telstar Arcade. (Telstar Combat! image by Wardyga. Telstar Arcade with cartridge n.1 on top, by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=38538814 Retrieved from https://en.wikipedia.org/wiki/Telstar_(game_console)#/media/File:Coleco-Telstar-Arcade-Pongside-L.jpg)

FIGURE 1.14 Screenshots of Telstar Arcade games (a) *Road Race* and (b) *Naval Battle*. (Screenshots and edits by Wardyga.)

FIGURE 1.15 Magazine advertisement for the Telstar Marksman (1978). (Scanned and edited by Wardyga.)

FIGURE 1.16 Nintendo's first home video game console, the Color TV-Game 6. (Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18301347. Retrieved from https://en.wikipedia.org/wiki/Color_TV-Game#/media/File:Nintendo-Color-TV-Game-Blockbreaker-FL.jpg)

FIGURE 1.17 First-generation console sales graph. (Graph designed by Wardyga using public data from Magnavox, Atari, and Coleco.)

Pro File: Ralph Baer Photo credit: Reddit user Nightwheel (4/9/09). Posted in 2015. Retrieved from http://i156.photobucket.com/albums/t29/nightwheel/RalphHBaerAutograph.jpg.

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Behind the Technology

OBJECTIVES

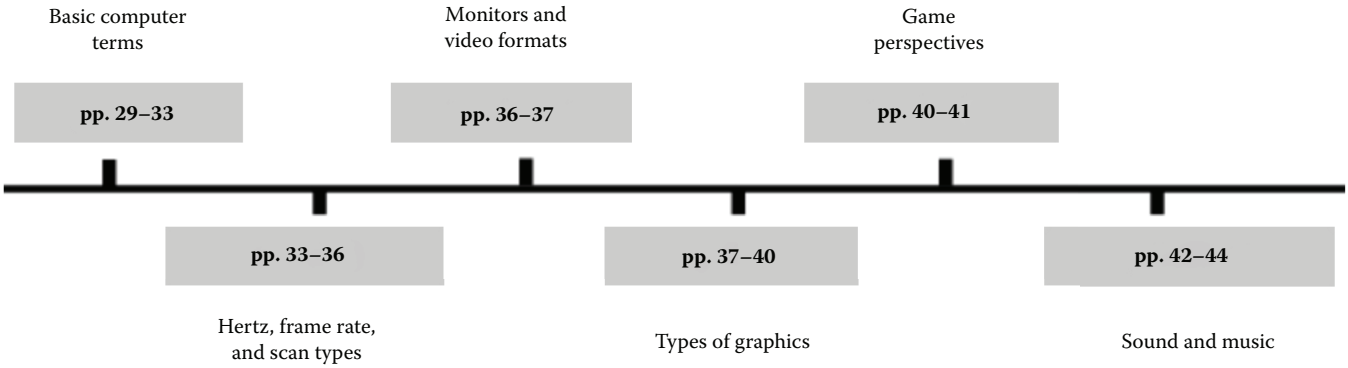
After reading this chapter, you should be able to:

- Summarize the main internal components of a PC and video game console.
- Translate acronyms such as RAM, ROM, and CPU and explain what each item is.
- Understand the basics on how a PC and video game console work.
- Be familiar with types of networks such as LANs, WANs, and the Internet.
- Differentiate between the video formats NTSC, PAL, and SECAM.
- Describe screen display properties such as hertz, frame rate, resolution, and so on.
- Be familiar with types of graphics such as ASCII, vector, raster, and polygons.
- Describe different characteristics of a game such as perspective, scrolling, and axis.
- Explain how sound and music development have evolved in gaming.
- Be familiar with notable video game music composers and voice actors.
- Summarize Stockburger's sound objects as they apply to video games.

■ KEY TERMS AND PEOPLE

Ambient effects
American Standard Code for Information Interchange (ASCII)
Aspect ratio
Audio/Sound card
Basic Input/Output System (BIOS)
Beat'em up
Binary digit/Bit (b)
Bitmap
Bump mapping
Bus/System Bus
Byte (B)
Cache memory
Cathode Ray Tube
Central Processing Unit (CPU)
Chiptune
Clock rate
Coaxial digital
Color overlays
Component
Composite
Cooling fan
Co-processor
Cores
Diegetic sound
DisplayPort
DVI
Effect sound
Ethernet
Expansion cards
Expansion slots
F Connector/Coaxial
First-person shooter
FLOPS
Forced progression
Frame rate
Frames per second
Free progression
Gigabyte (GB)
Gigahertz (GHz)
Gottfried Leibniz
Graphics (GFX)
Graphics/Video card
Graphics Processing Unit (GPU)
HDMI
Heads up display
Heinrich Hertz
Hertz (Hz)
High Definition Television (HDTV)
High Definition Video (HDV)
High-Definition Multimedia Interface
IEEE-1394/Firewire
Interface music
Interlaced scan
International System of Units (Si)
Internet
Kilobyte (KB)
Kilohertz (kHz)
Light-emitting diode
Liquid crystal display
Local area network
Megabyte (MB)
Megahertz (MHz)
Memory controller
Millions of Ops per Second (MIPS)
Modem
Monaural (Mono)
Monochrome
Motherboard
Motion blur
Multicore
Music composers
Musical Instrument
Digital Interface
National Television Standards Committee
Network Adapter
Non-Diegetic Sound
Organic Light-Emitting Diode
Out of Order Execution
Over-the-shoulder
Parallax scrolling
Parallel processing
Peripheral Component Interconnect (PCI)
Phase Alternate Line
Pixels
Plasma Display Panel
Polygon count
Polygon graphics
Ports
Progressive scan
Pulse-Code Modulation (PCM)
Random Access Memory (RAM)
Raster Graphics
Read-Only Memory
Role-Playing Game
SCART
Score/Soundtrack
Screen burn-in
Screen resolution
Scrolling
Second-person
Séquentiel Couleur À Mémoire (SECAM)
Shaders
Shoot'em Up
Soap Opera Effect
Sound effects
Sprites
Stereophonic (Stereo)
Stereoscopic (S-3D)
Strings (Binary)
Surround sound
Texture mapping
Third-person
Time-to-Solution
Top-Down/Overhead
Toslink/Optical
Ultra HD/4K
Universal Serial Bus
Vector graphics
VGA
Video Games Live
Vocalization
Voice actors
Voice synthesis
Wide area network
Wifi adapter
X Axis
XLR
Y Axis
Z Axis
Zone sound

■ CHAPTER OUTLINE



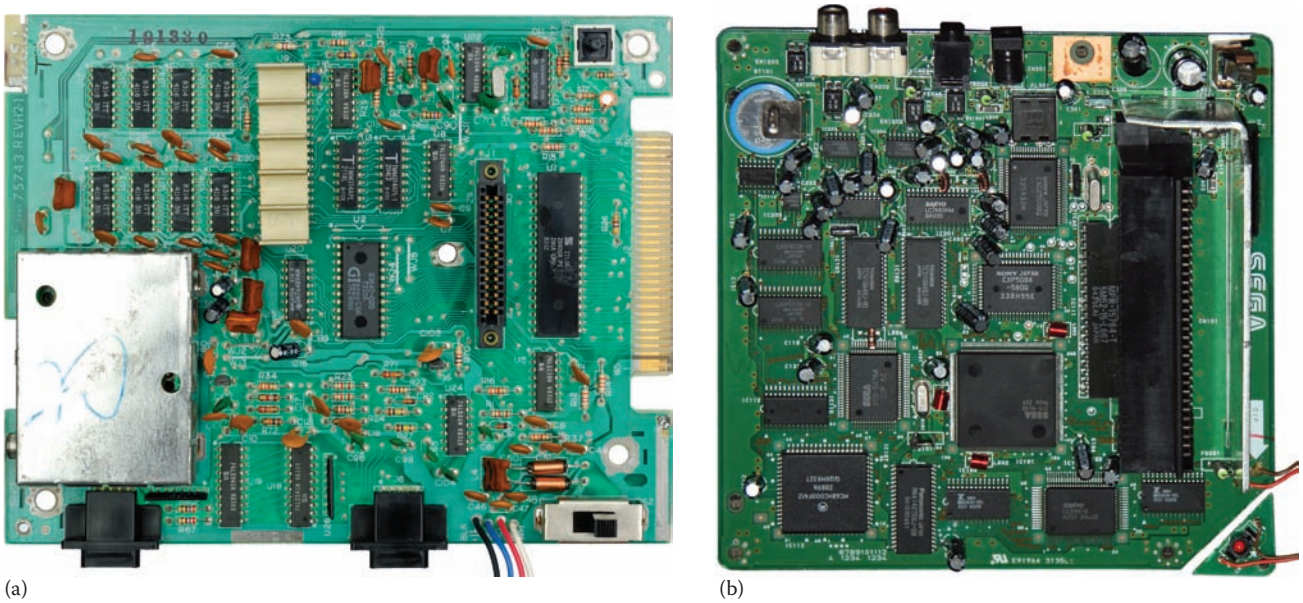
■ INTRODUCTION

Computers and video game consoles share many common components that allow these devices to play video games. Comparing this book's "tech specs" charts among consoles is one way to observe the hardware progression over each new generation of video games. While it can be interesting to compare these technical specifications, the figures mean very little without a moderate understanding of the technology behind the numbers. This chapter elaborates on much of the technical lingo used throughout the textbook. It can be revisited whenever a technical term requires further detail, examples, and/or illustrations. Like most of the text, information is presented in a logical order and chronologically as often as possible. These terms and technologies are also discussed under the respective generations in which they were introduced or became most popular.

■ UNDER THE HOOD

Like personal computers (PCs), video game consoles are made up of various circuits, cards, and other hardware. The main internal component each platform is built on is the **motherboard** (Figure 2.1). "The motherboard gets its name because it is like a mother to all of the other circuit boards." It's "the largest circuit board and has many smaller boards plugged into it" (Welch, 2002). Multiple components can be found attached to the motherboard, including one or more of the following basic parts: CPU, BIOS, RAM, ROM, graphics card, sound card, disk controller, expansion card, and modem/network card.

FIGURE 2.1 Motherboards from (a) ColecoVision (1982) and (b) Sega CD 2 (1993).



(a) (b)

■ CPU

The **central processing unit (CPU)** is like the brain of a computer or console. It makes calculations and processes information that tells the other components what to do. The technical specification for "processing speed" usually indicates the speed of the CPU. More powerful CPUs can make decisions more quickly. When starting up a video game, much of the program (music, levels, characters, etc.) is transferred to the RAM (explained below). The CPU then loads the program data from its RAM by a circuit called a **memory controller**. Finally, the CPU "processes" the program's instructions, such as what information to display on the screen. CPUs can generate a lot of heat and often require a small **cooling fan** to bring the temperature down. When CPUs overheat, it is not uncommon to hear the sound of the fan intensify as it speeds up to cool the CPU.

■ RAM AND ROM

RAM stands for **random access memory**. RAM is like the short-term memory of a computer, allowing data to be read, written, and stored—but only temporarily (Le Grange, 2015). RAM chips (Figure 2.2) store and retain information while the system is running, but will forget most of this temporary data when the unit is turned off. By storing information in a system's RAM, information such as the layout of a game map can be accessed quickly. The more RAM a system has, the more parts of a game it can load at once. When progressing through a game, the RAM is constantly freeing memory and loading more parts of the game from the hard drive or external ROM media.

ROM stands for **read-only memory**. It is different from RAM in that the information it stores cannot be altered or forgotten. Internally, ROM is primarily used to store the programs required to boot the gaming system. External ROM media includes game software such as cartridges and optical discs like DVD and Blu-ray. These ROM media contain information that communicates with the console or computer system, but the content on them cannot be changed or altered. Much of the game information on a ROM disc or cartridge is loaded onto the system's RAM to play the game.

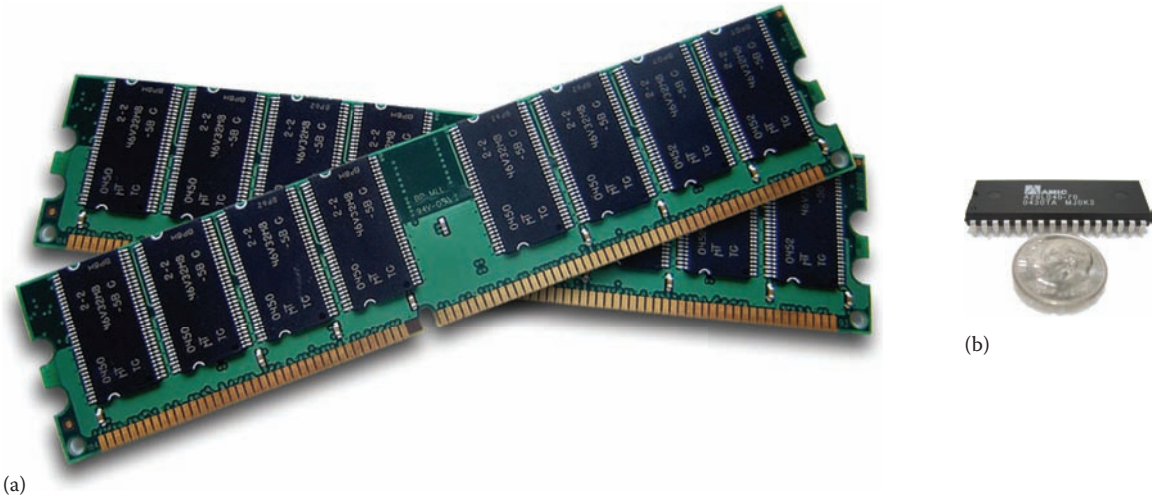
DID YOU KNOW?

The CD-ROM for *Ridge Racer* (Namco, 1995) loaded the entire game onto the PlayStation's RAM, eliminating loading and allowing players to replace the game disc with a music CD which it would use as the in-game music (GamePro, 1995, p. 37).

■ BIOS

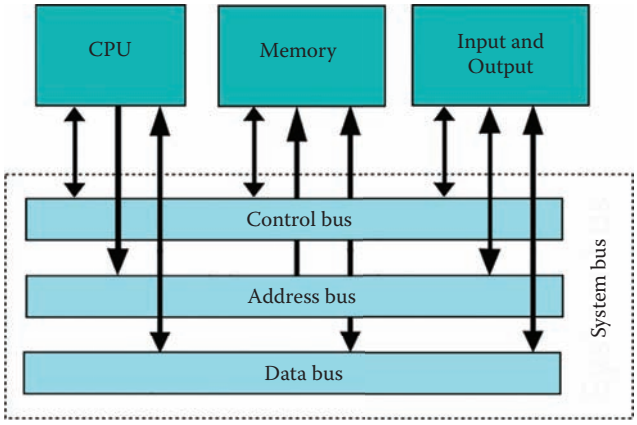
Another important computer component is the **BIOS chip**. BIOS stands for **Basic Input/Output System** and "in very simple terms, the BIOS chip wakes up the computer when you turn it on and reminds it what parts it has and what they do" (Welch, 2002). The BIOS is usually found on a ROM chip (called the ROM BIOS). It also serves as an important diagnostic tool, as it confirms the configurations and reliability of the system and allows it to use features of hardware by managing all inputs and

FIGURE 2.2 Typical RAM cards (a) and Amic erasable programmable ROM (b).



(a) (b)

FIGURE 2.3 Schematic diagram of a personal computer; note how the CPU must go through the system bus to communicate with the other components.



outputs. The CPU, memory, and BIOS communicate across the **system bus** as illustrated in Figure 2.3.

■ GRAPHICS AND SOUND CARDS

The **graphics card** (or **video card**) is responsible for producing output to the monitor or television. An important component of a graphics card is the **graphics processing unit (GPU)**. The GPU is the muscle behind the image that is displayed on the screen. Modern graphics cards also feature power input connectors and have their own internal cooling solutions.

The **sound card** (or **audio card**) contains special circuits that allow the system to process sound. Sound cards facilitate both the input and output of audio from the system. They can also be found in external devices such as game cartridges that use software to produce or enhance a game's sound. See Figure 2.4 for examples of each card.

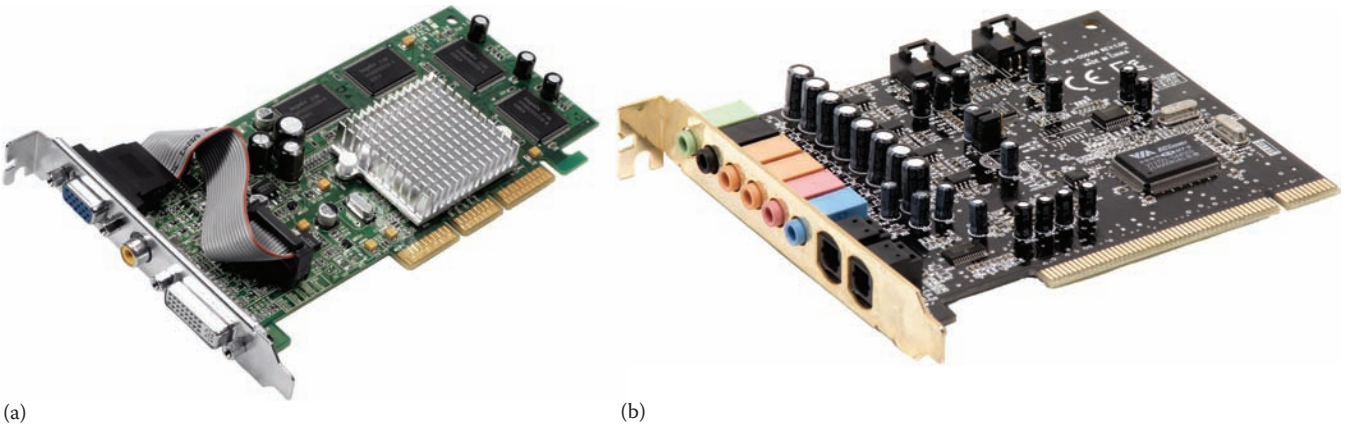
■ PORTS

Ports (also seen in Figure 2.4) are slots and connectors on the outside of computers and consoles for plugging in additional hardware such as gamepads, keyboards, mice, monitors, speakers, and other peripheral devices. "Ports are controlled by their **expansion cards** which are plugged into the motherboard and [usually] connected to other components by cables" (Welch, 2002). There are too many types of ports to mention in this chapter; however, two popular ports today include **High-Definition Multimedia Interface (HDMI)** and **Universal Serial Bus (USB)**. HDMI ports can transmit video and audio simultaneously and are the main port for connecting today's consoles to modern TVs. USB ports are used to connect everything from flash drives to printers, to game controllers and keyboards. They can even charge devices with rechargeable batteries. Like ports, many consoles have featured **expansion slots** for connecting add-on units such as the TurboGrafx-CD and Sega CD.

■ MAKING THE CONNECTION

PCI or **peripheral component interconnect** is a common means of connecting peripheral devices by providing a shared data path (called a "**bus**") between the CPU and peripheral controllers like graphics and sound cards. This is not to be confused with the **kernel**, which

FIGURE 2.4 AGP (Accelerated Graphics Port) Video Card (a) and Turtle Beach Sound Card (b); note how graphics and sound cards contain external ports for connectors.



(a) (b)

allows software to talk to the hardware. The kernel is a computer program that translates software code into data processing instructions for the CPU.

Modern computers and game consoles can be linked for cooperative and competitive play by networking them together. Common methods of networking computers include **local area networks (LANs)** and **wide area networks (WANs)**. LANs are a network of connected computers in a small geographical area such as in a home, computer lab, or small campus. WANs, on the other hand, cover a much larger geographical footprint between cities, states, countries, and even between nations. Figure 2.5 illustrates how numerous LANs can connect to form a WAN.

The conglomerate of these technologies is the **Internet**, "a worldwide collection of interconnected networks (internetworks or the Internet for short), cooperating with each other to exchange information using common standards. Through telephone wires, fiber-optic cables, wireless transmissions, and satellite links, Internet users can exchange information in a variety of forms" (Cisco Networking Academy, 2013).

Computers and consoles can be networked in a variety of ways. One method for connecting systems is through an expansion card called a **modem**. "A modem plugs the computer into a phone or cable line so that information can be transferred between computers" (Welch, 2002). A modem is required to connect to the Internet. Inside most modern PCs and consoles is a **network adapter** (also called a network card, network interface controller [NIC], LAN adapter, or WAN card, among other titles). The network adapter is a small circuit board that allows the system to communicate with other devices. For wireless connections, most devices now contain a **WIFI adapter** which can provide wireless band connectivity for applications such as multiplayer gaming (Le Grange, 2015).

■ BITS AND BYTES

While not a new term for computer techies, it wasn't until around the third generation of video games that many gamers began speaking in "bits," in anticipation of the upcoming "16-bit" consoles. A **bit (b)** is just an abbreviated word for **b**inary dig**it**. Every bit is either a 0 or a 1, collectively known as **binary code**. The basis for binary code was discovered by **Gottfried Leibniz** in 1679, illustrated in his article *Explication de l'Arithmétique Binaire.* Binary code is how all computer processing instructions are written using combinations of the binary digits 0 and 1. Zeros represent the command "off" or "no," while ones represent the command "on" or "yes." By themselves, these are only two distinct commands. "The millions of combinations of those two commands given in series are what make a computer work" (Welch, 2002).

FIGURE 2.5 LANs separated by geographic distance connected by a WAN.

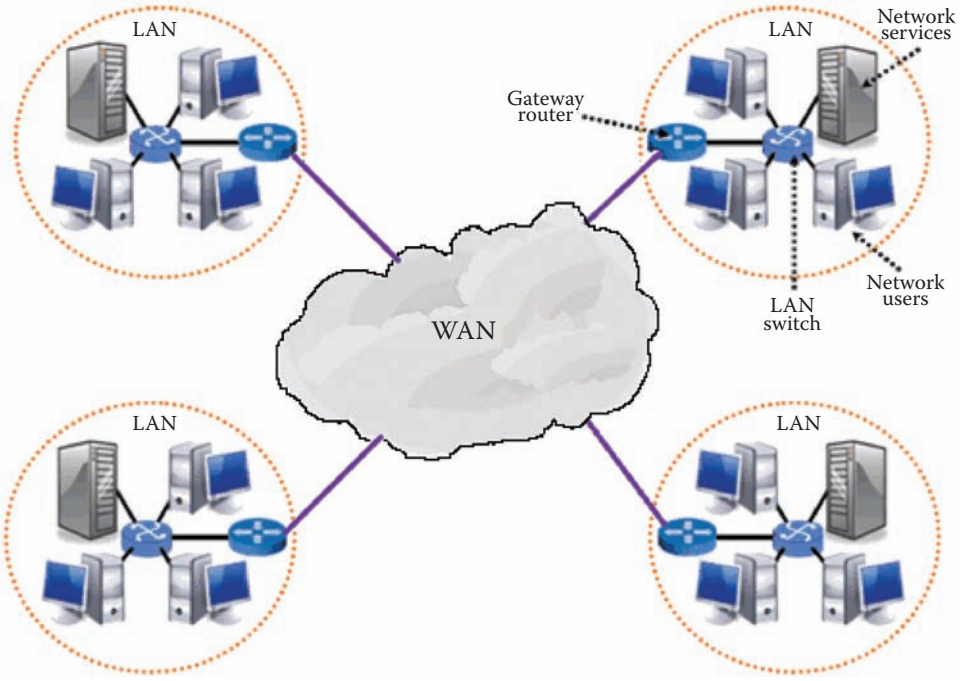


TABLE 2.1 Numbers in Binary Code		
0 = 0	6 = 110	13 = 1101
1 = 1	7 =111	14 = 1110
2 = 10	8 = 1000	15 = 1111
3 = 11	9 = 1001	16 = 10000
4 = 100	10 = 1010	17 = 10001
5 = 101	11 =1011	18 = 10010
6 = 110	12 = 1100	19 = 10011

Combinations of bits are called **strings**. Table 2.1 illustrates the simple formula for writing numbers in binary code. When a 1 is added to a 1 (as it is to make the number 2), the next bit becomes 0 (i.e., number 2 = 10 in binary code). Add another 1 and the next bit becomes a 1 (i.e., number 3 = 11 in binary code). Note how once all 1s are used in a string, another bit is added (with a string of zeros) and the sequence continues.

Eight bits grouped together form a **byte (B)**, and it is this size string that is usually used to represent an alphabetic character. The letter "A," for instance, is an 8-bit character written like this: 01000001 (Rieman, 1996). "When you type the letter A on your keyboard, electrical signals are sent from the keyboard to the CPU. The CPU turns the signals into binary code. Then, the computer reads the code and sends it on to the monitor to display the letter A" (Welch, 2002). Larger strings of bytes in metric multiples of 1,000 are given new names. For example, 1,000 bytes is called a **kilobyte (KB)** and 1,000 kilobytes equals a **megabyte (MB)**. See Table 2.2 for these and other common values of bytes.

Bits and bytes can form a lot more than just alphabetic characters. Strings of bits can correspond to a variety of different symbols and processing instructions. For an 8-bit platform, there are 256 possible combinations of 1/0 to work with. For game consoles and computers, the number of bytes represents the system's **memory capacity**. For instance, "if a computer has 64 MB of RAM, that means that the computer can handle 64,000,000 (64 million) bytes of random access memory" (Welch, 2002). In addition to RAM, hard drive space and software storage capacity are also measured in bytes.

TABLE 2.2 Common Multiples of Bytes (B)			
Unit	**Abbreviation**	**Metric Value**	**Binary Value**
Kilobyte	KB	1 thousand bytes or 1,000 kilobytes	1024 bytes
Megabyte	MB	1 million bytes or 1,000 kilobytes	1024^2 bytes
Gigabyte	GB	1 billion bytes or 1,000 megabytes	1024^3 bytes
Terabyte	TB	1 trillion bytes or 1,000 gigabytes	1024^4 bytes

■ HERTZ AND FRAME RATE

While memory and storage space are measured in bytes, processor speed and TVs/monitor refresh rates are measured in **hertz (Hz)**. Named after German physicist **Heinrich Hertz** (1857–1894) who proved the existence of electromagnetic waves, hertz is the unit of frequency in the **International System of Units (SI)**. Quite simply, hertz means "cycle per second." One hertz equals one complete cycle per second, 100 hertz means 100 cycles per second, and so forth (Table 2.3). In other words, a system with a 4.4 GHz processor has a **clock rate** of 4.4 billion times per second! Processor speed alone is not the only factor in determining how fast a console or computer will operate. Common components that contribute to CPU speed include **co-processors**, additional **cores** (processing units), and extra **cache memory** (a smaller, faster form of RAM).

For TVs and monitors, "a Hertz rating refers to the number of times per second the **pixels** [screen dots] used to display an image are refreshed" (Emigh, 2009). TVs in the United States run at 60 Hz (59.94 Hz), or at a refresh rate of approximately 60 times per second. Newer U.S. models can run at refresh rates of 120 Hz, 240 Hz, and even 480 Hz—although most people don't notice a major difference once refresh rates reach over 120 Hz. Higher refresh rates were developed for TVs and monitors to reduce **motion blur** that can occur during fast-moving action as seen in sports and many video games. Screens with refresh rates of 120 Hz and above typically look great for video games and sports broadcasts; however, such is not always the case when viewing movies shot on film. Coined the "**soap opera effect**" or **SOE**, high hertz TVs often contain motion smoothing/interpolation or motion estimation/motion compensation (ME/MC) processing that can make films look like they were shot on a camcorder. Fortunately, these motion features can

TABLE 2.3 Common Multiples of Hertz (Hz)		
Unit	**SI Symbol**	**Value**
Kilohertz	kHz	1,000 (10^3)Hz
Megahertz	MHz	1,000,000 (10^6) Hz
Gigahertz	GHz	1,000,000,000 (10^9) Hz
Terahertz	THz	1,000,000,000,000 (10^{12}) Hz

usually be turned off—allowing equal enjoyment for gaming, sports, *and* movie watching.

Frame rate is similar to hertz in that games with higher frame rates usually have less motion blur, but frame rate is measured by **frames per second (fps)**. The baseline for standard definition video in the United States is 30 fps (29.97 fps), however modern games commonly run at 60 fps. So, how does a game running at 60 fps or a Blu-ray movie running at 24 fps display properly on a television with a refresh rate of 120 Hz? In the case of a 24-fps movie, "even with higher refresh rates, there are still only 24 separate frames displayed every second, but they may need to be displayed multiple times, depending on the refresh rate. To display 24 frames per second on a TV with a 120 Hz refresh rate, each frame is repeated 5 times every 24th of a second" (Silva, 2016). Likewise, to display a 60-fps game on a TV with a 120 Hz refresh rate, each frame is repeated 2 times every 60th of a second.

DID YOU KNOW?

Refresh rates of TVs in parts of Europe and other countries using PAL and SECAM formats run at a lower baseline 50 Hz and 25 fps due to a different electric supply.

■ INTERLACED AND PROGRESSIVE SCAN

Television displays use one of two scanning methods to paint the picture on the screen. "Traditional video systems use an **interlaced scan**, where half the picture appears on the screen at a time. The other half of the picture follows an instant later (1/60th of a second)" (Briere and Pat Hurley, 2008). With interlaced scanning, each frame is comprised of two fields. The first field is made up of the screen's odd horizontal lines, while the second field contains the even horizontal lines. Interlaced scan was the main scanning system used for analog video displays before the advent of digital TV. Consoles connected to a TV with the yellow **composite cable** (and earlier analog video cables) can only output games using the interlaced scanning display format.

In contrast, a **progressive scan** system paints the entire picture within each field in *one* pass. See Figure 2.6 for a comparison. Similar to a higher refresh rate, games displayed in progressive scan typically move smoother and look sharper compared to games displayed via interlaced scan. Progressive scan capabilities became popular during the sixth generation of video games when systems like Dreamcast, PlayStation 2, Xbox, and GameCube were capable of being connected to TVs with optional red, green, and blue **(RGB) component cables**. Note that

FIGURE 2.6 Comparing interlaced and progressive scan on a 60-Hz display.

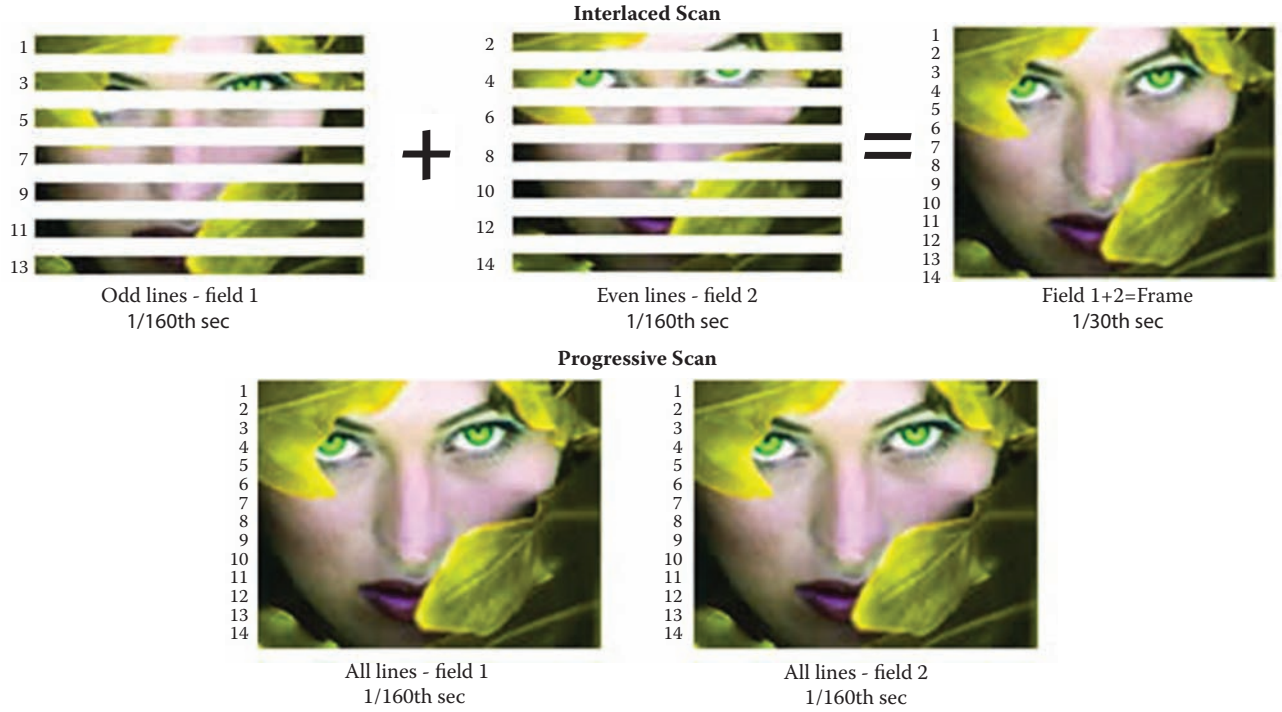


TABLE 2.4 Visual Reference Guide to Common Video Game Connectors

Connector	Name(s)	Audio Specs	Video Specs
	F Connector/coaxial	Analog, mono/stereo	720 × 576i @ 50 Hz 720 × 480i @ 60 Hz
	Composite/RCA/phono	Analog, mono/stereo	720 × 576i @ 50 Hz 720 × 480i @ 60 Hz
	S-video	Video-only	720 × 576i @ 50 Hz 720 × 480i @ 60 Hz
	SCART	Analog, mono/stereo	720 × 576i @ 50 Hz 720 × 480i @ 60 Hz
	Component/YP_BP_R	Video-only	up to 1920 × 1080p @ 50 or 60 Hz
	TRS (3.5 mm mini or 1/4" phone)	Balanced/unbalanced analog, mono/stereo	Audio-only
	XLR	Balanced analog, mono/stereo	Audio-only
	Coaxial digital	Digital 5.1/7.1 surround	Audio-only
	Toslink/optical or S/PDIF/digital audio	Digital 5.1/7.1 surround	Audio-only
	VGA	Video-only	Up to 2048×1536p (QXGA) @ 85 Hz
	DVI	Video-only	2560 × 1600 @ 60 Hz
	HDMI	Digital, 8 channels of 24-bit up to 192 kHz	2560 × 1600p @ 75 Hz 4096 × 2160p @ 60 Hz
	Display port	Digital, 8 channels of 24-bit up to 192 kHz	2560 × 1600p @ 75 Hz 7680 × 4320p @ 60 Hz
	USB	Data cable/varies	Data cable/varies
	IEEE-1394/firewire	Data cable/varies	Data cable/varies
	Ethernet	Data cable/varies	Data cable/varies

games must be programmed to output progressive scan, so playing interlaced scan titles through component cables will still result in an interlaced picture on screen. See Table 2.4 for these and other common connectors.

■ TYPES OF MONITORS

The round oscilloscope screen that displayed Willy Higinbotham's *Tennis for Two* (1958) and Steve Russell's *Spacewar!* (1962) was a type of **CRT** monitor. CRT is short for **cathode ray tube** and "works by moving an electron beam back and forth across the back of the screen. Each time the beam makes a pass across the screen, it lights up phosphor dots on the inside of the glass tube, thereby illuminating the active portions of the screen" (Beal, 2009, p. 1). CRT was the main type of television and computer monitor throughout the twentieth century until flat panel monitors took over in the early 2000s.

Flat panel monitors became popular due to their substantially thinner depth, lighter weight, higher energy efficiency, and the fact that they emit much lower radiation compared to CRTs. The first major flat panel monitor to be used for computer and television gaming was the **liquid crystal display (LCD)**. Like the title suggests, LCD contains a liquid crystal substance. "The molecules of this substance line up in such a way that the light behind the screens [is] blocked or allowed to create an image" (Khan, 2013). Early LCDs often suffered from a poor **viewing angle**. In other words, the picture would appear faded from the sides if not viewed from directly in front of the screen.

Plasma display panel (PDP) was the original competitor to LCD in televisions 30 inches and above, with the technology initially allowing for deeper shades of black and wider viewing angles. "A plasma display is an array of tiny gas cells sandwiched between two sheets of glass. Each cell acts like a mini fluorescent tube, emitting ultraviolet light which then strikes red, green and blue spots on the screen. These spots glow to build up the picture" (Laughlin, 2016). Early generation plasma displays were susceptible to a phenomenon known as "**screen burn-in**," where the shadow of a stagnant image could become permanently stuck on the screen if displayed for extended periods of time. This didn't bode well for video games, which often contain **heads up displays (HUDs)** such as time, life bars, score, and other data that remain on screen for the duration of the games. A plasma's glass screens can also lead to glare from reflected light, and because of their internal makeup, plasmas are often much heavier than other flat screen monitors.

Light-emitting diode (LED) displays are basically LCD monitors that are backlit with tiny light-emitting diodes instead of fluorescent tube backlights. LED displays have a more comparable contrast ratio to plasmas, can be thinner, and are usually more energy efficient than both plasmas and LCDs. On the horizon is **organic light-emitting diode (OLED)**, which uses a film of organic compound to emit light and produce an even higher quality picture. One concern for OLEDs is the limited lifespan of its organic materials. Organic or not, LED appears to be the key technology for monitors moving forward.

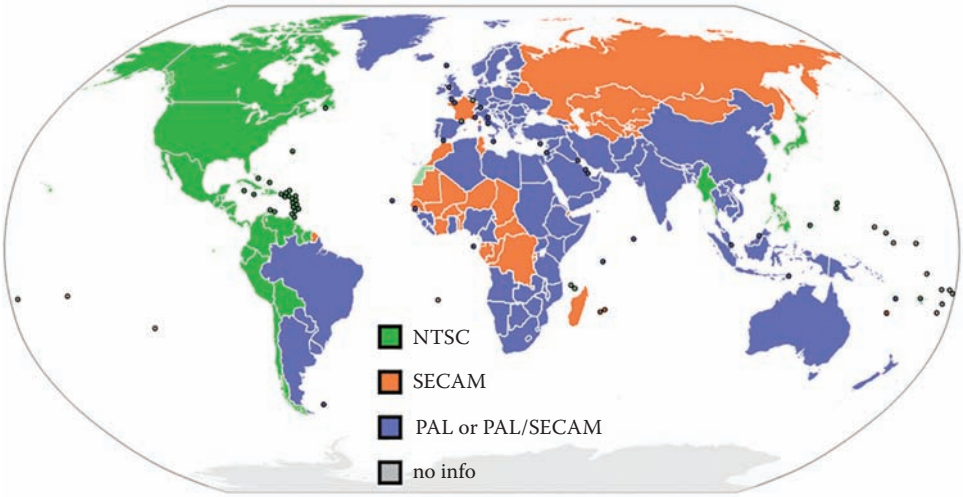
■ VIDEO FORMATS

There are three main video formats across the globe. **NTSC** or **National Television Standards Committee** is the format used in North America, Japan, South Korea, and a few other nations (see Figure 2.7). As mentioned earlier, NTSC televisions run at a baseline refresh rate of 60 Hz (59.94 Hz) and a frame rate of 30 fps (29.97). Early NTSC screens contained 525 scan lines (of which 483 were used to display the image) and a standard definition **aspect ratio** (width × height) of 4 × 3, which translates to a **screen resolution** of 720 × 480 rectangular pixels (equivalent to 640 × 480 square pixels on a computer monitor).

Phase Alternate Line (PAL) is the format used in most of Europe, Australia, and large portions of Africa and Asia. PAL televisions run at a baseline refresh rate of 50 Hz and frame rate of 25 fps. While PAL has a lower refresh rate and frame rate compared to NTSC, standard definition PAL TVs contain 625 scan lines (of which 576 are used to display the image [582 in the U.K.]). Like NTSC, the standard definition aspect ratio for PAL is 4 × 3; however, PAL has a higher screen resolution of 720 × 576 pixels.

Séquentiel Couleur à Mémoire (SECAM) is French for "Sequential Color with Memory." This was the first European color television standard and used predominantly in Russia, Eastern Europe, France, and parts of Africa. This format shares much of the same specifications as PAL with a baseline refresh rate of 50 Hz, frame rate of 25 fps, and a standard definition of 625 scan lines and 720 × 576 pixel resolution. It differs from PAL in that SECAM uses a different method of color transmission. See Figure 2.7 for a breakdown of television encoding systems by nation.

FIGURE 2.7 Television encoding systems by nation.



One of the goals with the introduction of **High Definition Television (HDTV)** was to unify these formats and eliminate incompatibility issues between countries. For all three formats, HDTVs have an aspect ratio of 16 × 9 and a screen resolution of 1920 × 1080 pixels. Even lower HD resolution formats such as **High Definition Video (HDV)** have resolutions of 1440 × 1080 pixels or 1280 × 720 pixels in every country. Resolution aside, the disparity between hertz remains today, with a baseline 60 Hz for NTSC region HDTVs versus 50 Hz for PAL and SECAM region HDTVs. Frame rate disparities also remain, with NTSC region HDTVs running at a baseline of 29.97 fps and PAL/SECAM region HDTVs running at a baseline of 25 fps (see Table 2.5). There is one universal frame rate though—all three formats can display the common "movie/film speed" of 24 fps. Newer **Ultra HD** or **4K** format displays resolutions of 3840 × 2160, which is noticeable on larger TV screens.

■ ASCII AND VECTOR GRAPHICS

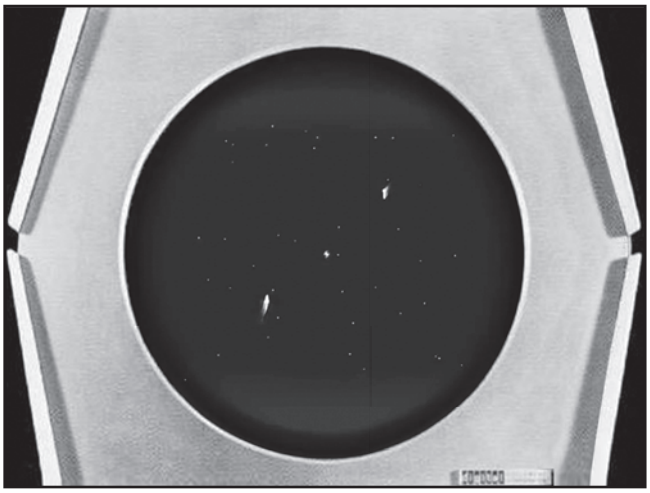
Whatever the display format, all video games are made up of some type of **graphics** (**GFX** for short). One of the early forms of video game graphics is **ASCII (American Standard Code for Information Interchange)**. ASCII graphics are essentially just text character symbols (like fonts in a word processing program). They can be seen in Steve "Slug" Russell's *Spacewar!* (1962) (Figure 2.8a) where text character symbols are used for the two dueling spaceships, missiles, and stars. One of the downsides to early graphics like ASCII was that they could only be displayed in **monochrome** (single color) displays.

Another form of graphics that became popular around the same times as ASCII is **vector graphics**. Vector graphics are made up of electron beam images—shapes based on mathematical equations of geometrical primitives such as points, lines, and curves. Examples of popular vector graphic arcade games include Atari's *Asteroids* (1979) and *Battlezone* (1980). Like ASCII graphics, vector graphics are entirely monochrome. And like other early arcade games before color, vector-based games often used **color overlays** to give the illusion of multiple colors on the screen. *Battlezone* (Figure 2.8) used a red and green overlay. The Vectrex home video game console (Western Technologies/Smith Engineering, 1983) was a completely vector display-based system with its own monitor. Vector monitors were another type of cathode ray tube (CRT) display. Due to their lack of color and the fact that they could only display a shape's outline, vector-based games began to disappear after around 1985 in favor of raster graphics.

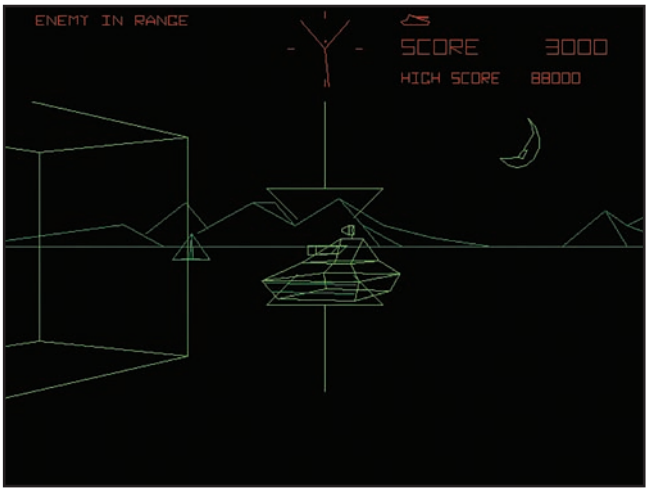
TABLE 2.5 Refreshrates, Frame Rates, and Resolutions Across Formats

Format	Refresh Rate	Frame Rate	Resolution (SD/HD)
NTSC	60 Hz	30 fps	720 × 480/1920 × 1080
PAL/SECAM	50 Hz	25 fps	720 × 576/1920 × 1080

FIGURE 2.8 Screenshots of (a) *Spacewar!* (ASCII GFX) and (b) *Battlezone* (vector GFX).



(a)



(b)

■ RASTER AND POLYGON GRAPHICS

Raster graphics are "made up of a collection of tiny, uniformly sized pixels, which are arranged in a two-dimensional grid made up of columns and rows. Each pixel contains one or more bits of information, depending on the degree of detail in the image" (Encyclopædia Britannica, 2016). Each grid coordinate is called a **bitmap**—a single-bit raster that corresponds with a specific color based on the number of bits stored in each pixel. To animate bitmaps on the screen without altering the data defining the graphics, most consoles in the 1980s used **sprite technology**. **Sprites** were invented as a way of combining unrelated bitmaps so that they appear to be part of a larger object, such as an animated character that can move around on the screen. Sprite size and the number of sprites that could be displayed on screen became popular tech specs in comparing early generations of video game consoles.

DID YOU KNOW?

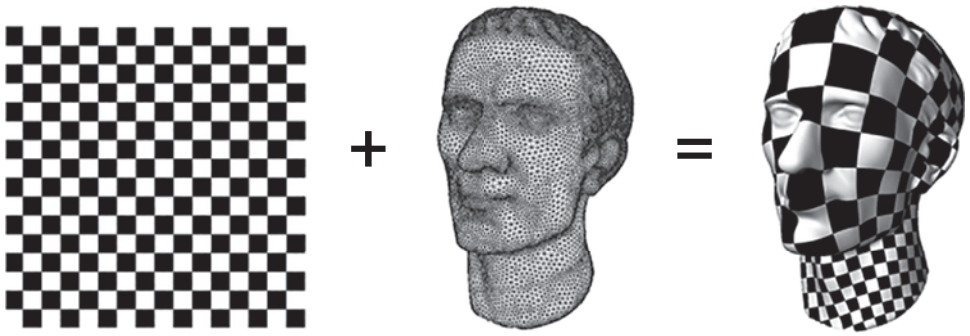
Unlike vector graphics, raster graphics and sprites do not stretch very well—distorting or becoming "pixilated" when zoomed upon in like on *Pilotwings* on SNES.

FIGURE 2.9 Screenshots of (a) *Super Mario Bros.* (raster GFX) and (b) *Super Mario 64* (polygons).

(a)

(b)

FIGURE 2.10 Texture mapping a checkerboard image onto a wireframe face.



The fifth generation of video games popularized **polygon graphics**. **Polygons** are geometric shapes that are "mapped" onto wireframe models to create 3D graphics. The term "3D" here refers to graphics having multiple sides and depth *within* the screen and should not be confused with **stereoscopic 3D technology,** which creates the illusion of objects protruding *beyond* the screen. See Figure 2.9 for a comparison between raster and polygon graphics. While all of the fifth-generation consoles emphasized polygonal gaming, it was Sony that really pressed developers to focus on 3D polygonal gaming for the PlayStation. This may have been because the PS1 was built specifically for 3D games and, in turn, very few true 2D titles were released for the system.

When reading the tech specs of fifth generation and later consoles, **polygon count** will refer to the number of polygons capable of being rendered per frame. Another important aspect of polygons is how they are mapped. Two common types of mapping include **texture mapping** (Figure 2.10)—wrapping a 2D "texture map" around a 3D object; and **bump mapping**—adding bumps or wrinkly textures that play off light.

■ SHADERS, FLOPS, AND CORES

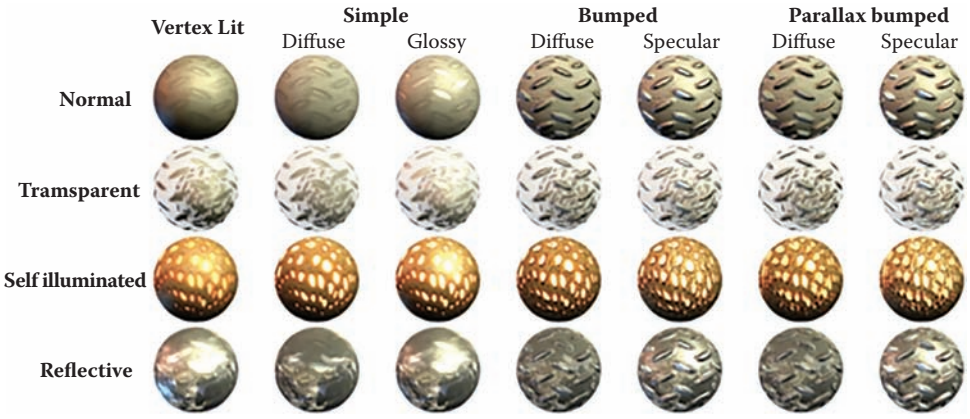
As 3D graphics technology progressed, more attention was given to the number of **shaders** (Table 2.6) a GPU could produce. While a texture is a 2D image, a shader is a program or cluster of instructions for drawing a surface. A texture almost always requires a shader, while shaders may or may not utilize textures. The greater the number of shader cores in a GPU, the more levels of contrast and special effects are available. Older graphics cards required separate processing units for each shader type; however, today's GPUs include "unified" shaders which can execute any type of shader.

In addition to being paired with attributes such as "diffuse," "glossy," or "specular," shaders can be given properties such as "normal," "transparent," "self-illuminated," and "reflective." as depicted in Figure 2.11. Some common shaders include "bumped diffuse (normal mapping)" shaders that emulate lighting of bumps without adding any geometry and "parallax specular" for creating displacement (where an object looks different from different angles and distances) (Hergaarden, 2011, p. 9).

TABLE 2.6 Types of Shaders

Name	Notes
2D	The only shader for adding textures to 2D pixels
3D	Including primitive, vertex, geometry, and tessellation shaders
Compute	General purpose; used in graphics pipelines for extra effects
Unity	Can execute any type of shader

FIGURE 2.11 Shader examples from the built-in Unity Shaders Matrix (Unity, 2010).



With more compute units and stream processors to work from, GPUs took center stage after the turn of the century and polygon count became a secondary technical specification to a system's **floating point operations per second (FLOPS)**. A "flop" is a basic unit of computational power that serves as an indicator for graphics processing speeds. For example, GPUs of seventh-generation consoles were clocked between 12 gigaflops or "GFLOPS" (Wii) and 240 GFLOPS (Xbox 360). The subsequent wave of consoles contained even faster GPUs that could push multiple teraflops or "TFLOPS" (Table 2.7).

While FLOPS provide a clearer sense of graphics processing speeds for comparing consoles, there are other numbers such as a system's **MIPS (millions of instructions per second)** that go into determining how efficient a console is at processing data in a specific amount of time, often referred to as the "**time-to-solution**." Then there is technology like **parallel processing**, which allows for more than one calculation or execution process to be carried out simultaneously—a type of computation that can be expanded by the number of "cores" a processor contains.

Game consoles were introduced with **multicore** processors starting with the Xbox 360's 3.2 GHz PC Tri-Core Xenon CPU. With a tri-core processor, each core functions as a separate processor, resulting in faster computing and more efficient energy consumption. The PlayStation 3 was even more complex, with a 3.2 GHz multicore cell processor that was "essentially seven microprocessors on one chip, allowing it to perform several operations at once" (Altizer, 2016, para. 8). Note that core architecture can vary from one manufacturer to another, making it difficult to compare them directly.

With the Wii U, Nintendo chose to go with an enlarged cache and a process called **Out of Order Execution (OOE)** (Amas, 2013, para. 3). OOE is a paradigm used by high-end microprocessors. Unlike older processors that executed instructions by their original order in a program, OOE processors can carry out instructions in a nonlinear fashion based on input data as it becomes available. In other words, the processor can preload data in the background (cache), rather than remaining idle until the system calls for something to be processed.

■ A MATTER OF PERSPECTIVE

Perspective plays an important part in the manner in whichs a game is played and experienced. In a **first-person**

TABLE 2.7 Common Multiples of FLOPS

Unit	Abbreviation	Value
Megaflops	MFLOPS	1,000,000 (10^6)
Gigaflops	GFLOPS	1,000,000,000 (10^9)
Teraflops	TFLOPS	1,000,000,000,000 (10^{12})
Petaflops	PFLOPS	1,000,000,000,000,000 (10^{15})

perspective game like the *Call of Duty* series, the action takes place through the eyes of the character being controlled. This is the perspective used in **first-person shooter (FPS)** titles, which often requires greater accuracy for shooting and a wider field of view. Seeing through the character's viewpoint in FPS games can be immersive; however, the player is often limited to only seeing the character's hands and arms, but usually little else.

Third-person titles take place behind the character being controlled, where generally the entire body of the character appears on screen. This perspective is popular for many action games where combat and attention to the environment are of equal importance. Some third-person games can be viewed from a closer, **over-the-shoulder (OTS)** perspective like in *Resident Evil 4* and *Gears of War*. This is often the case in third-person shooters where shooting is a priority and shouldn't be confused with **second-person** games. Second-person games include titles where you are viewing the action from afar, but not from directly behind the character like in third-person games. Examples of second-person perspective games include *Double Dragon, Final Fight*, and other **beat'em up** style games viewed from more of a side angle.

Isometric games such as *Baldur's Gate* and *Disgaea* take place from a diagonal overhead view. These types of games were made popular by early **role-playing games (RPGs)** and strategy titles, giving the games a pseudo-3D perspective often referred to as **2.5D**. Then there are **top-down** or **overhead** games that provide a straight down, aerial view of the action. This perspective has been a popular choice for early generation RPGs, as well as vertical **shoot'em ups** like the *Raiden* and *Dodonpachi* series. See Figure 2.12 for some examples of some of these common game perspectives.

Isometric and overhead games have their roots in 2D gaming; however, modern variations of these game perspectives often render such graphics using non-fixed angle 3D polygons for a greater sense of depth. And while first-person and third-person perspective games have their roots in 3D (utilizing the three-dimensional plane called the **Z axis**), games are only considered **true 3D** if objects in the game appear to extend beyond the boundaries of the screen, such as in **stereoscopic (S-3D)** video games.

Scrolling is the term used for the direction(s) in which the game plays. Early games such as *Pac-man* and *Space Invaders* do not scroll at all. Games like *Super Mario Bros.* that typically scroll from left to right (**X axis**) are called "side-scrolling" games. Games that scroll vertically (**Y axis**, most often upward) are called "vertically scrolling" games. Some games (like the shoot'em ups *Zaxxon* and *Viewpoint)* scroll diagonally. Games that move in virtually every direction without constraint are referred to as "free-scrolling" games. Of course, games can also utilize a combination of scrolling methods.

To create a sense of depth in 2D sprite-based games, a common technique for fourth-generation developers was to create separate background (and sometimes foreground) layers in games, which scrolled at different speeds. This is known as **parallax scrolling**, where the furthest background layer scrolls slowest, with each subsequent layer scrolling faster. Some late third-generation games like *Ninja Gaiden 3* and *Mega Man 6* also used this technique.

Beyond the direction in which a game scrolls is the manner in which it encourages the player to progress. Games typically contain two styles of progression. Games with **forced progression** keep the player moving with time limits or forced-scrolling levels like in most

FIGURE 2.12 Common video game perspectives: (a) First–Person (GoldenEye 007), (b) Third–Person (Tomb Raider), and (c) Isometric (Popolo Crois).

(a) (b) (c)

TABLE 2.8 Summary of Video Game Perspective Terms					
Perspective	First-Person	Second-Person	Third-Person	Isometric	Top-Down
Dimensions	2D	2.5D	3D	True/S-3D	
Scrolling	Horizontal	Vertical	Diagonal	Multiple	None
Axis	X (left-right)	Y (up-down)	Z (in-out)		
Progression	Forced	Free	Mixed		

arcade-style games. Arcade games make higher profits "the more often they're played, so a moving perspective that literally pushes the player forward quickly became the standard" in the arcades (Egenfeldt-Nielsen, Smith, & Tosca, 2012, p. 140). In **free progression** games, players can explore and progress through the game at their leisure, without the pressure of a time limit or other constraints. This type of gameplay became more popular as home console technology advanced and could offer more exploration-style games like the *Tomb Raider* and *Zelda* series. See Table 2.8 for a summary.

■ SOUND CHANNELS

Sound and music play an integral part in the video game experience, setting the mood, conveying emotion, and often providing the motivation to progress forward through a game. Early consoles output **monaural (mono)** sound, which is a single channel of audio. In monaural sound, there would be no difference between the sound being pumped out of a left speaker or right speaker in a two-speaker setup. Most early household televisions output mono sound because they were manufactured with only one speaker. **Stereophonic (stereo)** sound allows for two separate audio channels. With stereo sound, different sounds can be emitted between two speakers, which can provide for a sense of directionality when used appropriately. For example, in a well-produced stereo video game shooter, one might hear gunshots from the left speaker when an enemy is firing from the left side of the screen, through both speakers when the enemy is directly ahead, or from the right speaker when an enemy is firing from the right side of the screen.

Surround (multichannel) sound takes this experience even further, allowing game developers to program sound to appear behind the player for even greater immersion. Surround sound uses between four and seven independent audio channels, which are usually identified with a number. For instance, 5.1 surround

FIGURE 2.13 7.1 channel surround sound speaker setup floor plan by Denon.

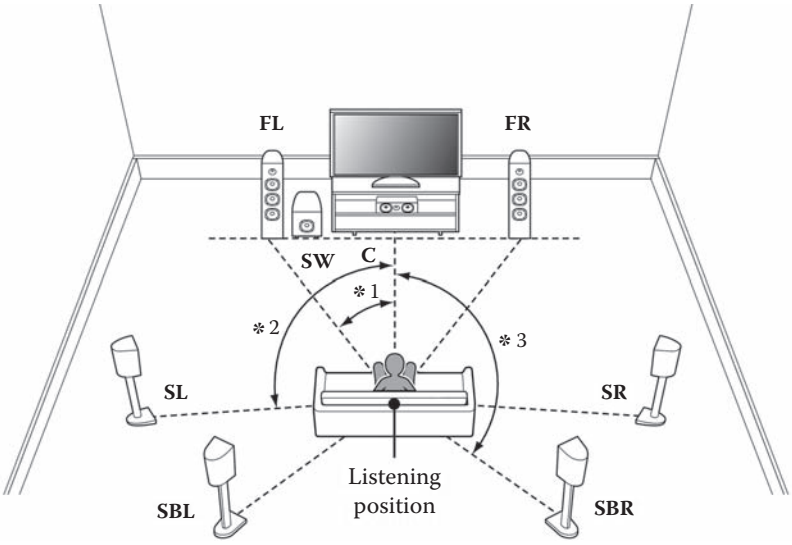


TABLE 2.9 Five Notable Video Game Music Composers

Composer	Game Series Contributions
Harry Gregson-Williams	*Metal Gear Solid, Call of Duty*
Koji Kondo	*Super Mario, Legend of Zelda, Star Fox, Punch-Out!!*
Yoko Shimomura	*Kingdom Hearts, Mario & Luigi, Street Fighter II*
Jeremy Soule	*Elder Scrolls, Guild Wars, Total Annihilation, Harry Potter*
Nobuo Uematsu	*Final Fantasy, Chrono Trigger, Blue Dragon, The Last Story*

means five main channels of sound (front left, front center, front right, back left, and back right) with the .1 occupying a sixth channel for the subwoofer (bass). 6.1 channel surround sound adds a center rear speaker, and 7.1 channel sound (Figure 2.13) adds two additional side speakers.

■ MUSIC AND SOUND

In the late 1970s music was stored on physical media such as compact cassettes and phonograph records. These components were expensive and fragile, leading to the development of digital sound where computer chips could change electrical impulses from binary code into analog sound waves. "Some systems could play actual sound recordings while others used **MIDI [Musical Instrument Digital Interface]**-like formats (in the MIDI format a sound file is simply a series of references to sounds which are then played back by the sound card)" (Egenfeldt-Nielsen, Smith, & Tosca, 2012, p. 146). Such early music was usually monaural and looped, or used sparingly at the start of the game or between stages. Beyond the technology that creates the music is the fundamental basis of its usage and what kind of impression the video game music makes on the player.

Some of the earliest notable background music in a video game can be credited to Taito's arcade hit *Space Invaders* (1978). The music consisted of only four looped bass notes, but the pace of the soundtrack would accelerate as the aliens got closer and faster to invading the bottom of the screen—increasing the urgency of the situation (and often the heart rate of the player). As video game technology progressed, multiple music tracks could be programmed for games. Changing musical themes to accommodate the on-screen action was a major part of *Donkey Kong* (1981), which included different melodies for the stage intro, stages, and loss of a life—as well as changing music when Jumpman obtained a hammer or rescued Pauline.

As the medium progressed, more channels of sound could be incorporated into arcade cabinets and home gaming consoles. The third generation of video games is where many of the first memorable video game soundtracks were born. The term **"chiptune"** was created to describe the synthesized electronic music of this 8-bit generation. **Pulse-code modulation (PCM)** eventually allowed for the use of sound sampling, such as the percussion sounds in *Super Mario Bros 3* (1990). This technology led to the sampling of a myriad of instruments to create many memorable game soundtracks beginning in the mid-to-late 1980s. Video game composers such as Nobuo Uematsu (*Final Fantasy*), Koji Kondo (*Super Mario Bros., The Legend of Zelda*), and Yuzo Koshiro (*Shinobi, ActRaiser, Streets of Rage*) began to receive worldwide acclaim. See Table 2.9 for some of gaming's most notable composers.

Stereo and surround sound would later become available in video games, creating an even richer sound experience. Video game music has now grown to include the same breadth and complexity associated with television and movie soundtracks, allowing for much more creative freedom (Rogers, 2014). Many games have produced such popular music that a separate soundtrack CD is often made available to consumers.

As game music progressed, so did the use of voice. One of the first arcade games to feature authentic **voice synthesis** was Stern Electronics' *Berzerk* (1980) where robots would shout phrases like "Get the humanoid!" and "Intruder alert!" (McDonald, 2004). Mattel's Intellivision was the first to market voice synthesis in a home console with its "Intellivoice" adapter. By adding this side-mounted cartridge to the system, a handful of games could utilize a voice synthesizer to generate audible speech. Until optical media, however,

FIGURE 2.14 Behind the voices: Faces of five prolific video game voice actors.

Troy Baker | Steve Blum | Jennifer Hale | Mark Hamill | Nolan North

speech in video games was sparse since it took up a lot of memory. Most early games that featured speech only included short words and phrases. Once this limitation was lifted with CD-ROM and laserdisc, **vocalization** (voice acting for video game characters) became much more conventional. Today, it is not uncommon for voice actors to deliver thousands of lines of dialogue in a single video game.

There are numerous **voice actors** who have made a name in the video game industry. Some of gaming's most prolific voice actors (shown in Figure 2.14) include: Troy Baker (*BioShock Infinite* and *The Last of Us*), Steve Blum (who holds the Guinness World Record for most appearances in video games), Jennifer Hale (*Mass Effect, Metroid Prime, Metal Gear Solid*, and countless others), Mark Hamill (*Batman: Arkham Asylum/City* and *Darksiders*), and Nolan North (*Assassin's Creed, God of War, Infamous*, and *Uncharted*, among others).

TABLE 2.10 Stockburger's Sound Objects

Sound Objects	Definition	Examples in *Civilization IV*
Interface	Sounds heard during set-up or menu options	• Theme song "Baba Yetu" • Music playing while game loads
Speech	Any spoken text	• Narrative by Leonard Nimoy • Phrases spoken by military units
Zone	Sounds that reflect location	• Naturalistic sounds (oceans waves, tree branches falling) • Battle sounds
Effect	Sounds that reflect an action or event	• Sounds accompanying discovering treasure, religion, etc. • Sounds of declaring war or peace
Score	Soundtracks	• Diplomacy themes • Terrain soundtrack

■ SOUND THEORY

There are two main types of sound in games: **diegetic sound** and **non-diegetic sound**. Diegetic sound comes from *within* the game world and includes both *direct* sounds (guns firing, swords clashing, character dialog) and *ambient* sounds (wind, thunder, whistling birds). Non-diegetic sound takes place *outside* the game world, such as mood music and narrative dialog. Scholars such as Karen Collins, Rod Munday, Isabella van Elferen, and Axel Stockburger have deconstructed these sounds "from a theoretical perspective, helping to form vocabularies and modes of investigation that enable discussion of the uses of sound within video games" (Donnelly, Gibbons & Lerner, 2014, p. 168). According to Stockburger, **effect sound** includes sounds that reflect an action or event, such as discovering a treasure, while **zone sound** reflects location, such as sounds in the environment. **Interface music** includes themes heard during game menus or loading screens, while **score** is the background music that plays during the core of the game. See Table 2.10 for Stockburger's sound objects as they apply to the strategy game *Civilization IV*.

DID YOU KNOW?

Game composers Tommy Tallarico and Jack Wall launched **Video Games Live (VGL)** in 2005. Conducted by Emmanuel Fratianni, video game scores are performed by a live orchestra, along with video game footage, live actors, lighting, and other effects.

■ ACTIVITY: PITCH A GAME

Publishers and developers are always looking for new ideas for video games. Do you have a concept for a video game that could revolutionize the industry? Give it a shot!

GUIDELINES

This assignment touches the surface of a full video game proposal, requiring only a pitch and/or logline and a fact sheet. Typically, this would be used to gauge whether there is interest in your idea, which if the case, would be followed by a more detailed proposal.

Pitch/logline: In one to two sentences, summarize your game concept as clearly as possible. It often helps to relate it to familiar ideas or existing games; for example, "*Street Fighter* meets *Final Fantasy* in this epic action RPG where random encounters result in real-time 2D battles between one or more opponents."

Fact Sheet: Use the format below to construct your fact sheet with some selling points. Each section should be approximately three sentences each.

What: "What" is the concept and is like the logline
Why: "Why" is the purpose; show the game is original and why it will sell.
Who: "Who" is star(s) of the game. Mention talent or lead voice actors here.
Where: "Where" is the place of distribution, console(s), and/or online network.
When: "When" is the production timeline; milestone schedule, release date, etc.
How: "How" is how it will be funded, developed, and published.

■ CHAPTER 2 QUIZ

1. Acts like the brain of a computer or game console; makes calculations and processes information that tells other components what to do:
   a. CPU
   b. GPU
   c. RAM
   d. ROM

2. Is like the short-term memory of a computer; allowing data to be read, written, and stored—but only temporarily:
   a. CPU
   b. GPU
   c. RAM
   d. ROM

3. A network of connected computers in a small area such as in a home or computer lab:
   a. BIOS
   b. LAN
   c. WAN
   d. Internet

4. Processor speed and TV/monitor refresh rates are measured in:
   a. Bytes (b)
   b. Kilobytes (KB)
   c. Hertz (Hz)
   d. Frames per second (fps)

5. The baseline frame rate for standard definition video in the United States is:
   a. 15 fps
   b. 24 fps
   c. 25 fps
   d. 30, or 29.97 fps

6. The three video formats used around the world are:
   a. NTSC, PAL, and SECAM
   b. NTSC, PAL, and SKYNET
   c. UNLV, PAL, and SECAM
   d. NTSC, PAL, and UNLV

7. What does NTSC stand for?
   a. North To South Coast
   b. National Television Stations Collaboration
   c. National Televisions Standards Committee
   d. National Televised Social Club

8. Which television formats use 625 lines at 50 Hz?
   a. PAL & UNLV
   b. PAL & SECAM
   c. SECAM & NTSC
   d. NTSC & UNLV

9. Compared to PAL, analog NTSC video format has a:
   a. Higher resolution
   b. Higher frame rate (fps)
   c. Faster refresh rate (Hz)
   d. Both B and C

10. Atari's *Asteroids* (1979) and *Battlezone* (1980) are examples of:
    a. ASCII graphics
    b. Vector graphics
    c. Raster graphics
    d. Polygon graphics

11. These graphics consist of geometric shapes that are "mapped" onto wireframe models to create 3D graphics.
    a. ASCII graphics
    b. Vector graphics
    c. Raster graphics
    d. Polygon graphics

12. In this field of view, the player sees through the perspective of character's eyes:
    a. First-person
    b. Second-person
    c. Third-person
    d. Isometric

13. Games like *Super Mario Bros.* that typically scroll from left to right predominantly utilize the:
    a. X axis
    b. Y axis
    c. Z axis
    d. None of the above

14. What effect gives 2D games a sense of depth by the illusion of a third dimension?
    a. Large sprites
    b. High resolution pixels
    c. Parallax scrolling
    d. 8-bit sound

15. Early consoles output a single channel of audio where there was no difference between the sound output of a left speaker or right speaker in a two-speaker setup. This kind of audio output is called:
    a. Monaural (mono)
    b. Stereophonic (stereo)
    c. Surround (multichannel)
    d. None of the above

16. According to Stockburger, _____ includes sounds that reflect an action or event, such as discovering a treasure.
    a. effect sound
    b. zone sound
    c. interface music
    d. score

True or False

17. A bit (b) is just an abbreviated word for binary digit.

18. The television format PAL stands for Photon Aluminum Luster.

19. The interlaced scan system paints the entire picture within each field in one pass and provides smoother motion and sharper picture compared to games displayed using progressive scan.

20. LED (light-emitting diode) displays are basically LCD monitors that are backlit with tiny light-emitting diodes instead of fluorescent tube backlights.

■ FIGURES

FIGURE 2.1 Motherboards from (a) ColecoVision (1982) and (b) Sega CD 2 (1993). (Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34995064. Retrieved from https://commons.wikimedia.org/wiki/File:ColecoVision-Motherboard-Top.jpg#/media/File:ColecoVision-Motherboard-Top.jpg. Game console--Sega CD--motherboard--171-6528C-A, by ZyMOS. Available at http://www.happytrees.org/chips, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=9809478. Retrieved from https://commons.wikimedia.org/wiki/File:Game_console--Sega_CD--motherboard--171-6528C-A.jpg#/media/File:Game_console--Sega_CD--motherboard--171-6528C-A.jpg)

FIGURE 2.2 Typical RAM cards (a) and Amic erasable programmable ROM (b). ([a] By Utente: Sassospicco - own work, CC BY-SA 2.5. Available at https://commons.wikimedia.org/w/index.php?curid=860883. Retrieved from https://commons.wikimedia.org/wiki/File:RAM_module_SDRAM_1GiB.jpg. Modified by Wardyga. [b] AMIC EEPROM 512KB 8 bit 32-pin memory chip, removed from a DVD player, by Yanrayaj - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=7389609)

FIGURE 2.3 Schematic diagram of a personal computer; note how the CPU must go through the system bus to communicate with the other components. (Courtesy of W Nowicki - own work, based on a diagram which seems to in turn be based on page 36 of *The Essentials of Computer Organization and Architecture* by Linda Null, Julia Lobur, http://books.google.com/books?id=f83XxoBC_8MC&pg=PA36, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=15258936. Simplified diagram of a computer system implemented with a single system bus. This modular organization was popular in the 1970s and 1980s.)

FIGURE 2.4 AGP (accelerated graphics port) video card (a) and Turtle Beach sound card (b); note how graphics and sound cards contain external ports for connectors. ([a] By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11451358. Retrieved from https://commons.wikimedia.org/wiki/File:AGP-Video-Card.jpg#/media/File:AGP-Video-Card.jpg. [b] By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11960881 Retrieved from https://commons.wikimedia.org/wiki/File:Turtle_Beach_Sound_Card_(Catalina).png#/media/File:Turtle_Beach_Sound_Card_(Catalina).png.)

FIGURE 2.5 LANs separated by geographic distance connected by a WAN. (Courtesy of Audit3 - own work, CC BY-SA 4.0. Available at https://commons.wikimedia.org/w/index.php?curid=49623752. Retrieved from https://commons.wikimedia.org/wiki/File:Lanwan.gif.)

FIGURE 2.6 Comparing interlaced and progressive scan on a 60-Hz display. (From AnchorBayTech. Editorial: Interlaced vs. Progressive Scan. February 26, 2009. Retrieved from http://www.anchorbaytech.com)

FIGURE 2.7 Television encoding systems by nation. (By Akomor1 - own work; derived from File:BlankMap-World6.svg, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=2314395. Retrieved from https://commons.wikimedia.org/wiki/File:PAL-NTSC-SECAM.svg#/media/File:PAL-NTSC-SECAM.svg.)

FIGURE 2.8 Screenshots of (a) *Spacewar!* (ASCII GFX) and (b) *Battlezone* (vector GFX). (Courtesy of Wardyga.)

FIGURE 2.9 Screenshots of (a) Super Mario Bros. (raster GFX) and Super Mario 64 (polygons). Screenshots of Super Mario Bros. (Nintendo, 1985) and Super Mario 64 (Nintendo, 1996).

FIGURE 2.10 Texture mapping a checkerboard image onto a wireframe face. (From Saboret, L., Alliez, P., & Lévy, B., 2013. Planar parameterization of triangulated surface meshes. Retrieved from http://doc.cgal.org/latest/Surface_mesh_parameterization/index.html)

FIGURE 2.11 Shader examples from the built-in Unity Shaders Matrix (Unity, 2010). (Materials and shaders, from Documentation Unity3D, by the Unity Team on September 16, 2010. Retrieved from http://unity.ogf.su/Documentation/Manual/Materials.html)

FIGURE 2.12 Common video game perspectives. (Screenshots from *GoldenEye 007* (Rare, 1997), *Tomb Raider* (Core Design, 1996), and *PopoloCrois* (G-Artists, 2005).)

FIGURE 2.13 7.1 channel surround sound speaker setup floor plan by Denon. (Courtesy of Denon. Editorial: Speaker installation, 2014. D&M Holdings Inc. Retrieved from http://manuals.denon.com/avrx4100w/na/EN/GFNFSYawzxoxsr.php)

FIGURE 2.14 Behind the voices: Faces of five prolific video game voice actors. (Headshots of Troy Baker, http://www.behindthevoiceactors.com/troy-baker/; Steve Blum, http://www.behindthevoiceactors.com/steve-blum/; Jennifer Hale, http://www.behindthevoiceactors.com/jennifer-hale/; Mark Hamill, http://www.behindthevoiceactors.com/mark-hamill/; and Nolan North, http://www.behindthevoiceactors.com/nolan-north/)

■ TABLE CREDITS

TABLE 2.4 Visual reference guide to common video game connectors. Images adapted from Crane, K. (2016). *Home A/V connections glossary*. Retrieved from https://www.crutchfield.com/S-b7lDiytxYTv/learn/learningcenter/home/connections_glossary.html.

TABLE 2.8 Summary of video game perspective terms. Adapted from table and concepts presented in Egenfeldt-Nielsen, S., Smith, J., & Tosca, S. (2012, July 28). *Understanding video games: The essential introduction* (2nd ed). New York, NY: Routledge.

TABLE 2.10 Stockburger's Sound Objects table from Donnelly, K., Gibbons, W., & Lerner, N. (2014, February 27). "Stockburger's sound objects" table from *Music in video games: Studying play*. New York, NY: Routledge. Table based off Stockburger, A. *The game environment from an auditive perspective*. Retrieved from http://www.audiogames.net/pics/upload/gameenvironment.htm.

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The Second Generation

OBJECTIVES

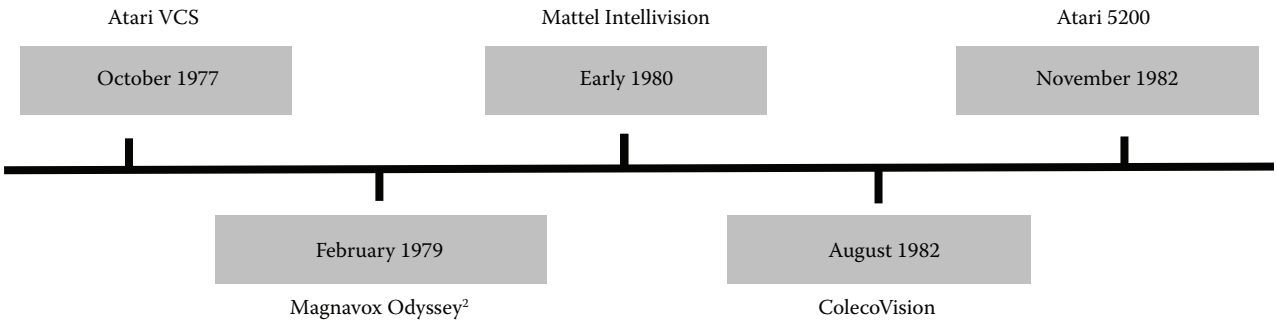
After reading this chapter, you should be able to:

- Describe the climate of video games in the arcade and in homes during this time.
- Discuss the "Golden Age" of the arcade and identify some key arcade titles.
- Recognize key people who helped pave the way for the top games and consoles.
- Summarize a brief overview of the history of Mattel.
- Be familiar with the technological differences among second-generation systems.
- Have a sense of the graphics quality and general capabilities of second-generation video game consoles.
- Review some of the key video game titles for each console.
- Illustrate how Atari dominated the second-generation market.
- Explain several reasons for the North American video game crash of 1983.
- List the important innovations brought to gaming during this time period.
- Summarize second-generation market sales, breakthroughs, and trends.

■ KEY TERMS AND PEOPLE

360-degree joystick
ANTIC
Minoru Arakawa
Asteroids
Atari VCS/2600
Atari 5200
Automatic switchbox
Don Bluth
Ron Bradford
Eric Bromley
Nolan Bushnell
Bus
Chuck E. Cheese's
ColecoVision
Color palette
Colors on screen
Computer-controlled opponent (AI)
Console war
Controller ports
Don Daglow
Digital data pack
Directional disk
Donkey Kong
Rick Dyer
E.T.
Easter Egg
Expansion modules
Fairchild Channel F
Fairchild Semiconductor
Galaxian
Manny Gerard
GTIA
Elliot Handler
Home port
Intellivision/II
Intellivoice
INTV Corporation
Toru Iwatani
Joystick
Ray Kassar
Michael Katz
Keyboard component
Steve Lehner
Ed Logg
Master Strategy Series
Harold Matson
Mattel
Midway
Jay Miner
Shigeru Miyamoto
MOS Technology
Namco
NEC
Nintendo
Tomohiro Nishikado
Numeric keypad
Odyssey^2
Overlays
Pac-Man
Philips
George Plimpton
POKEY
Lyle Rains
RF switch
RAM
RCA Studio II
Warren Robinett
Roller controller
ROM
Steve Ross
SALLY
Kazunori Sawano
Sears Super VideoArcade
Sears Video Arcade
Mario Segale
Shovelware
Sound channels
Space Invaders
Super Action Controller Set
Taito
TandyVision
Tele-Games
TIA
Texas Instruments
The Voice
Trak-Ball controller
Terrence Valeski
Vectrex
Video Entertainment System
Video game crash
Videocarts
Warner Communications
Howard S. Warshaw
Yars' Revenge
Gunpei Yokoi

■ CONSOLE TIMELINE



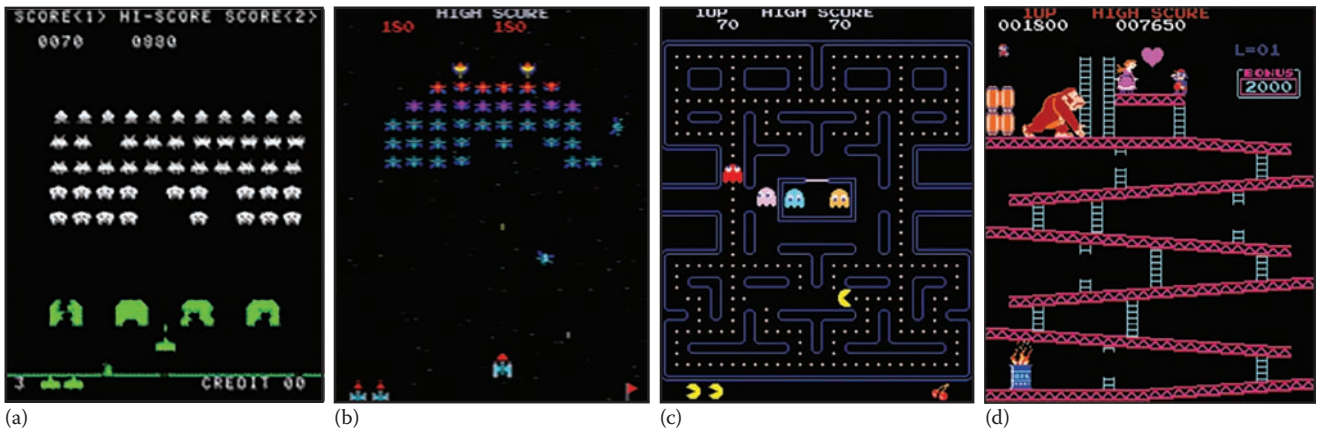
■ THE GOLDEN AGE

The Golden Age of the arcades (Figure 3.1) began with the popularity of **Taito**'s ***Space Invaders*** (1978) and lasted into 1983, when the market crashed in North America. Part of *Space Invaders*' success may have been from the world's craze over *Star Wars*, which designer **Tomohiro Nishikado** mentioned to be an influence for the game's theme (Game Informer, 2008, p. 108). The arcade game was known for its four notes of looped music, which sped up as the aliens descended closer to the earth (and the player). It also advanced the concept of a high score, which encouraged gamers to survive for as long as possible. Atari responded with their hit shooter ***Asteroids*** (1979) by **Lyle Rains** and **Ed Logg**. Soon there would be an explosion of arcade venues such as Nolan Bushnell's **Chuck E. Cheese** franchise, opening a window of creativity for numerous publishers.

Once such publisher, **Namco** (Nakamura Amusement Machine Manufacturing Company) found early success as a distribution partner with **Atari** and **Midway**. Their hit shooter ***Galaxian*** (1979) expanded upon *Space Invaders* with true color graphics and other gameplay enhancements. A year later, Namco released ***Pac-Man*** in 1980. *Pac-Man* became the video game industry's first mascot—a pop culture icon that spawned an animated TV series and a hit music single by Buckner & Garcia called "Pac-Man Fever," among countless ancillary items. *Pac-Man* creator **Toru Iwatani** was successful in his goal to reach the female audience (Purchese, 2010), helping the title become the highest grossing arcade game of all time. Other hits released in 1980 included Atari's *Missile Command* and *Battlezone*, along with *Berzerk* by Stern Electronics. See Table 3.1 for some of the best games from each year during the Golden Age.

A year after Pac-Man took the world by storm, Nintendo visionary **Shigeru Miyamoto** released his first arcade hit with ***Donkey Kong*** in 1981. Overseen by chief engineer **Gunpei Yokoi**, Miyamoto's *Donkey Kong* pioneered the platform game genre, was one of the first to have a substantial narrative, and even provided a sense of humor (Latson, 2015, para. 2). It was the first title to feature Nintendo's iconic Mario character (known then as "Jumpman") and put Miyamoto on course to become arguably the most innovative video game designer of all time. Other hits in 1981 included Namco/Bally-Midway's *Ms. Pac-Man*, Williams Electronics' *Defender*, Konami/Sega's *Frogger*, as well as Atari's *Tempest* and *Centipede*.

FIGURE 3.1 Screenshots of defining arcade games from the Golden Age: (a) *Space Invaders* (1978), (b) *Galaxian* (1979), (c) *Pac-Man* (1980), and (d) *Donkey Kong* (1981).



(a) (b) (c) (d)

TABLE 3.1 A Sampling of the Top Arcade Games from the Golden Age by Year

Year	Title	Designer	Publisher	Notes
1978	*Space Invaders*	Tomohiro Nishikado	Taito	Launched the Golden Age of the Arcades
1979	*Galaxian*	Kazunori Sawano	Namco/Midway	Progressed the use of color graphics
1980	*Pac-Man*	Toru Iwatani	Namco/Midway	Top grossing arcade game
1981	*Donkey Kong*	Shigeru Miyamoto	Nintendo	Narrative, platformer, first appearance of Mario
1982	*Pole Position*	Toru Iwatani	Namco/Atari	Advanced the arcade racing genre
1983	*Dragon's Lair*	Don Bluth/Rick Dyer	Cinematronics	Popularized LaserDisc games

DID YOU KNOW?

Donkey Kong was made to convert 2000 unsold cabinets of Nintendo's *Radar Scope* game in America. Jumpman was renamed "Mario" by Nintendo President **Minoru Arakawa** after a heated argument with Nintendo of America's warehouse landlord **Mario Segale** over unpaid rent money (Kent, 2001, pp. 157–159).

Revenue from arcade video game cabinets grew tremendously during this time, from $50 million sales in 1978 to $900 million in 1981 (Wolfe, 2007, p. 105). The Golden Age of arcade games continued through 1982 with chart toppers like Taito's *Jungle Hunt*, Nintendo's *Popeye*, Gottlieb's *Q*Bert*, Williams Electronics' *Robotron: 2084*, along with Namco's *Pole Position* and *Dig Dug*. A 1982 *Play Magazine* study estimated there to be 24,000 full arcade venues and 400,000 street locations where video games could be found in America—consisting of more than 1.5 million arcade machines (Kent, 2001, p. 152). Game cabinets could be found nearly everywhere—from restaurants and supermarkets, to gas stations, and even doctors' offices. How long could this momentum last? Let's first look at what was happening in the home console market during this period.

■ THE SECOND GENERATION

There were over a dozen consoles released during the second generation. This chapter will focus primarily on the five systems that sold 1 million units or more. The system that launched the second generation was the **Fairchild Channel F** in November of 1976. Released by **Fairchild Semiconductor** for $169.95, the Channel F is notable for being the first game console with programmable ROM cartridges (called "**videocarts**"). It was also the first home video game system to use a microprocessor. Only around 26 games were developed for the system and approximately 250,000 units were sold. Two months later, **RCA** released its **Studio II**. The system lacked color support and did not even have control paddles. Only about a dozen games were made and it was discontinued in 1978.

■ ATARI VCS (2600)

Knowing that Atari needed a successor to its Home Pong system in order to remain competitive in the home video game market, **Nolan Bushnell** consulted his Grass Valley team to design a microprocessor built off of the **MOS Technology 6502** (Kent, 2001, p. 99). The result was a lower-costing 6507 custom chip named "**Stella**," coupled with a display and sound chip called the **Television Interface Adaptor (TIA)** by **Jay Miner**.

To raise enough money to manufacture and market the console, Bushnell sold Atari to media publisher **Warner Communications** for $28 million and was allowed to remain on board as chairman. With Warner's funding, the **Atari Video Computer System (VCS)** launched for $199 on September 11, 1977 and landed on most store shelves by mid-October. It came bundled with two controllers and the game cartridge *Combat* among its 9 launch titles (Table 3.2). A rebranded version of the VCS called the **Sears Video Arcade** was sold exclusively through Sears, Roebuck and Company stores, along with rebranded games with more generic looking "**Tele-Games**" labels.

TABLE 3.2 Atari Video Computer System U.S. Launch Titles

- Air-Sea Battle (Figure 3.3a)
- Basic Math
- Blackjack
- Combat (Figure 3.3b)
- Indy 500
- Star Ship
- Street Racer
- Surround
- Video Olympics

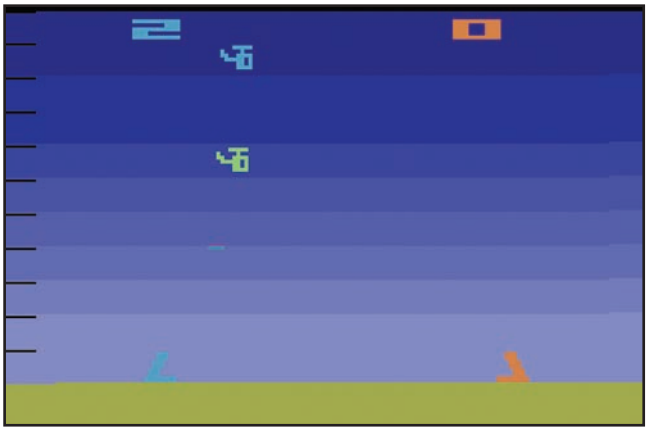
FIGURE 3.2 Atari VCS, often called "The Atari," with standard, digital joystick controller.

The VCS (Figure 3.2) introduced many innovations to the home video game market. In addition to the common paddle controllers, the Atari VCS came with a digital "**joystick**" controller which was well suited for multidirectional games. It also came with built-in switches for selecting game variations and difficulty, as well as a toggle switch for black and white or color displays. Another breakthrough for the system was that many of its games included a **computer-controlled opponent**, rather than the standard two-player or asymmetric challenges of previous console games (Monfort & Bogost, 2014, p. 5).

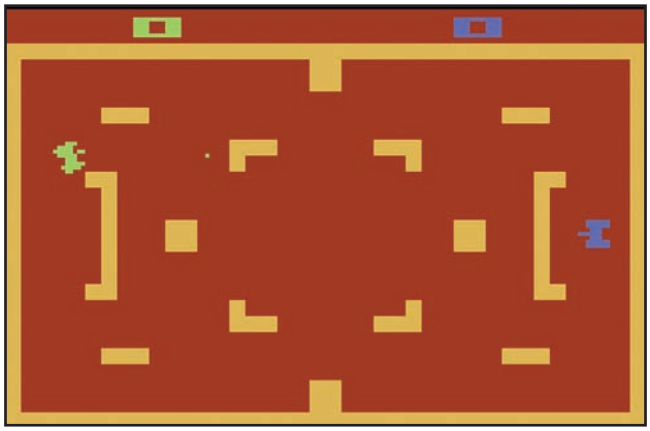
One aspect that began to change at Atari under Warner Communications was the laid back, unconventional ways Nolan Bushnell had originally run the operation. Programmers were used to coming to work late, staying late, and partying hard. "Bushnell encouraged their laid-back attitude and had no problem with them partying after, and sometimes during, work hours" (Kent, 2001, p. 180). Owner **Steve Ross** and Co-Chief Operating Officer **Manny Gerard** often found themselves at odds with Bushnell, who proposed to discontinue the VCS in favor of new technology in 1978.

In February of that year, Warner hired executive vice-president of Burlington Industries **Ray Kassar** to oversee the consumer division of Atari. A Harvard graduate and East Coast businessman, Kassar was the exact opposite of Bushnell. While Bushnell wanted to discontinue the

FIGURE 3.3 Screenshots from Atari VCS launch titles (a) *Air-Sea Battle* and (b) *Combat*.



(a)



(b)

PRO FILE

NOLAN BUSHNELL

KEY FACTS:

Made first coin-operated arcade video game "Computer Space"

Mainstreamed video games with "Pong" and the Atari VCS

PRO FILE

HISTORY:

- Born: February 5, 1943, Clearfield, Utah

EDUCATION:

- University of Utah College of Engineering, degree in electrical engineering (1968)

CAREER HIGHLIGHTS:

- Formed Syzygy in 1969 to release the first coin-op video game Computer Space with Ted Dabney
- Founded Atari, Inc.with Dabney in 1972
- Hired engineer Al Alcorn to develop Pong, the first successful coin-operated video game
- Pioneered Pizza Time Theatre, which became the successful Chuck E. Cheese's arcade chain

RECOGNITION:

- Inducted into the Sony Entertainment Metreon Walk of Fame in 2005 under the Lifetime Achievement category, along with Shirgeru Miyamoto.

VCS, Kassar wanted to position the system as Atari's #1 product heading into the 1978 holiday season. Further conflict between Bushnell and Warner ensued until that November when Bushnell was forced to resign and Kassar became Atari's CEO. Bushnell bought back the rights to his **Chuck E. Cheese's** restaurant which became the most successful family arcade chain in the United States.

Kassar admittedly knew nothing about video games and approached the business more from a marketing perspective. His high society lifestyle also clashed with game designers, who often felt underappreciated by him. Despite these conflicts, Kassar achieved what he set out to do and Atari VCS sales eventually skyrocketed. "The year before Kassar became CEO, Atari had $75 million in sales. Under Kassar, Atari became the fastest-growing company in the history of the United States [for its time], as the company's sales exceeded $2 billion within three years" (Kent, 2001, p. 185).

Success did not come without its losses. Kassar's underappreciation of Atari's game designers led to many of them leaving the company. One such group included some of Atari's top designers who parted ways after unsuccessfully attempting to negotiate for more compensation. They may have left Atari, but they did not abandon the industry. In April of 1980, programmers David Crane, Alan Miller, Bob Whitehead, and later Larry Kaplan would form the first independent developer and distributor of console video games—**Activision**. Activision went on to produce some of the console's best titles and eventually became one of the top video game publishers in the world.

DID YOU KNOW?

Designer Howard Scott Warshaw named his 1981 VCS game *Yars' Revenge* after Ray Kassar by reversing the letters of his first name. "Yar" = "Ray," that is, "Ray's Revenge" (Campbell, 2015, p. 4). Was this revenge on Activision or just an inside joke?

■ CONSOLE COMPARISON

The Atari VCS was light years ahead of the other systems on the market at the time of its release. While the Magnavox Odyssey and RCA Studio II lacked TV sound output and could only display a monochromatic image, the VCS contained a 2-channel sound chip and could display multiple colors on screen (Table 3.3). The only competition for the VCS early on was the Fairchild Channel F. The Channel F's 1.79 MHz processor ran faster than Atari's **1.19 MHz 6507 processor**; however, Atari's console displayed a higher resolution of **160 × 192 pixels** compared to the Channel F's resolution of 128 × 64.

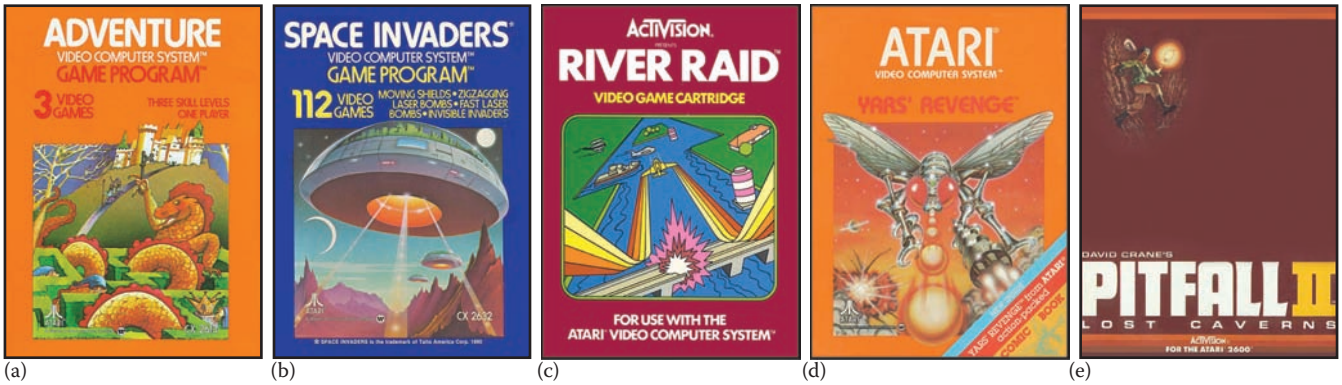
The VCS had twice the amount of memory with **128 bytes of RAM** (random access memory) and **4 KB ROM** (read-only memory), compared to Channel F's 64 bytes of main RAM and 2 KB of VRAM (video RAM). While both systems were limited to only **4 colors per scan line**, Atari had a much larger color palette to choose from—**128 possible colors** compared to just eight colors on the Channel F. Sound was still primitive at this time, but the overall audio from the VCS was much more capable and diverse compared to the beeps and crackles from the Channel F.

TABLE 3.3 Atari Video Computer System Tech Specs

Manufacturer:	Atari
Launch Price:	$199.95
Release Date:	October 1977 (US), 1978 (EU), 1983 (JP)
Format:	Cartridge
CPU:	8-bit MOS Technology 6507 processor (1.19 MHz)
Memory:	128 bytes RAM & 4 KB ROM
Resolution:	160 × 192 pixels
Colors:	4 on-screen colors from a palette of 128
Sound:	2 channel mono

FIGURE 3.4 Magazine advertisement for the Atari Video Computer System in 1981.

FIGURE 3.5 Box art to five of the best VCS titles including from: (a) *Adventure*, (b) *Space Invaders*, (c) *River Raid*, (d) *Yars' Revenge*, and (e) *Pitfall II: Lost Caverns*.



(a) (b) (c) (d) (e)

HEAD-TO-HEAD

To compare the graphics and sound between the Atari VCS and Fairchild Channel F, play similar games from each console (or watch video clips of them). Some games to compare include *Desert Fox* (Channel F) versus *Combat* (VCS), *Spitfire* (Channel F) versus *Time Pilot* (VCS), and *Pinball Challenge* (Channel F) versus *Breakout* (VCS).

■ KEY ATARI VCS TITLES

One of the moves that helped Atari secure its stronghold on the home video game market was when Gerard and Kassar negotiated a deal with arcade rivals Taito and Midway to develop a home port (conversion) of Space Invaders for the VCS. The success of Space Invaders (1980) led to Atari licensing many other popular arcade hits for its home console, which proved to be a winning formula with consumers (Maher, 2012, para. 2). A number of these titles can be seen in Figure 3.4 and 3.5.

One of the system's most notable titles was *Adventure* (1979) by **Warren Robinett**. Adventure was the system's first open world, action-adventure style game and is often credited as the first video game to include an **Easter egg**—a secret room containing text that credited Robinett for the game's creation. Some of the best action-adventure games were developed by Activision, such as *Pitfall!* (1982) and *H.E.R.O.* (1984).

Two titles known mostly for their failure included *Pac-Man* and *E.T. the Extra-Terrestrial* from 1982. *Pac-Man* was a disastrous port of the arcade classic. The maze layout was nothing like the arcade, the ghosts flickered and lacked the original game's vivid colors, and Pac-Man controlled terribly. The port was the best-selling VCS game of all time, but ultimately disappointed most of the 7 million people who purchased it.

Later that year Atari struck a deal with Steven Spielberg to produce a game based on the hit movie *E.T.* Best-selling game designer **Howard Scott Warshaw** (*Yars' Revenge, Raiders of the Lost Ark*) was given the daunting task of completing the game in under six weeks in order to market the game for the holidays (Kent, 2001, p. 238). The game was a complete failure. According to Kassar, about 3.5 million of the 4 million games produced were sent back to Atari as unsold inventory or customer returns (Bruck, 1995, pp. 179–180). Atari infamously buried the unsold games in a New Mexico desert landfill.

■ MAGNAVOX ODYSSEY²

In an attempt to remain relevant in the industry it helped to create, Magnavox released the **Odyssey²** (Figure 3.6) in the U.S. during February of 1979 for $179. The system released in Europe as the Philips Videopac G7000 (among other names) and in Brazil as the Philips Odyssey. With home computers beginning to gain popularity around this time, Magnavox chose to market the Odyssey² as more of a home computer with marketing phrases such as "The Ultimate Computer Video Game System" and "A Serious Educational Tool." To expand upon this image, the Odyssey² came with a full, 49-key computer keyboard and released a programming cartridge called *Computer Intro!*. Eleven other cartridges were available at launch, many of which contained more than one game as seen in Table 3.4.

The original build of the system came with silver joysticks that could be plugged and unplugged from the back

FIGURE 3.6 Magnavox Odyssey^2 with built-in membrane keyboard and updated joysticks.

of the unit. Later models (such as the ones with black controllers) were hardwired into the rear of the unit. The console's biggest strength may have been its speech synthesis unit called "**The Voice**," released in the United States in 1982. This add-on peripheral plugged into the top of the system and added speech, music, and sound effects enhancement for certain games. Phrases such as "Ouch! Help!" could be heard in *Smithereens* and "You blew it!" in *P.T. Barnum's Acrobats* (Cassidy, 2008, p. 16).

Another achievement the Odyssey^2 should be remembered for was pioneering the fusion between board games and video games with its **Master Strategy trilogy**. These games included *The Quest for the Rings* (1981), *Conquest of the World* (1981), and *The Great Wall Street Fortune Hunt* (1982). Each title was packed with extended memory, a tabletop game board, and various accessories. The games played similar to *Dungeons & Dragons* and followed a storyline reminiscent of J. R. R. Tolkien's *The Lord of the Rings*.

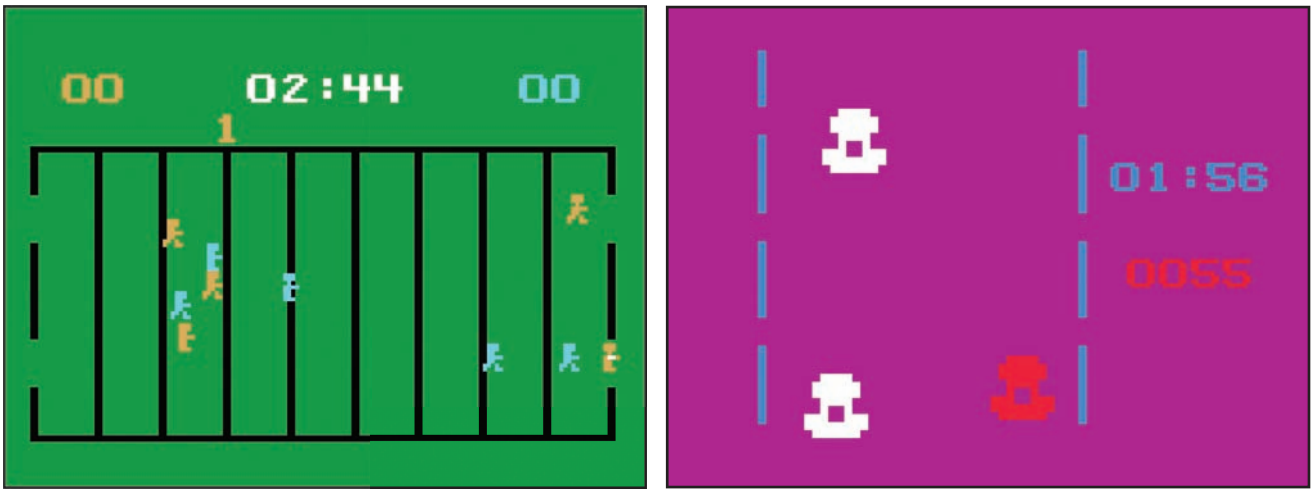
Most of the Odyssey^2's first party games were designed and packaged by **Ron Bradford** and **Steve Lehner**. A lot of these titles were clones of other more popular games. For instance, *Armored Encounter!* (1978) looked and played almost identically to *Combat*. *Alien Invaders - Plus!* (1980) was a blatant clone of *Space Invaders*; and *K.C. Munchkin!* (1981) led to a lawsuit from Atari because of its similarities to *Pac-Man*.

While the Atari VCS did not start off with independent or third-party developers, it was the support of companies like Activision, Imagic, and Parker Brothers that helped the VCS dominate the second generation with an extensive library of games. Parker Brothers and Imagic eventually released titles for the Odyssey^2, although many of these games never made it to American shores.

TABLE 3.4 Magnavox Odyssey^2 U.S. Launch Titles

- Armored Encounter/Sub Chase!
- Baseball!
- Bowling!/Basketball!
- Computer Golf!
- Cosmic Conflict!
- Football! (Figure 3.7a)
- Las Vegas Blackjack!
- Matchmaker!/Buzzword!/Logix!
- Math-a-Magic!/Echo!
- Speedway! (Figure 3.7b) /Spin-Out!/Crypto-Logic!
- Take the Money and Run!

FIGURE 3.7 Screenshots from Odyssey² U.S. launch titles (a) *Football!* and (b) *Speedway!*



(a) (b)

■ CONSOLE COMPARISON: ODYSSEY² VERSUS ATARI VCS

Like the Fairchild Channel F, the Odyssey²'s **1.79 MHz** processor ran faster than the VCS's 1.19 MHz 6507 processor (Table 3.5). It also could display a slightly higher resolution at **160 × 200 pixels**, compared to 160 × 192 pixels on Atari's console. On the other hand, its **64 bytes** of internal **RAM**, coupled with **128 bytes** of **audio/video RAM** could not compete with Atari's 128 bytes of RAM and 4 KB of ROM.

Furthermore, the Odyssey² had a somewhat limited ability to generate graphics. It was challenging (although not impossible) for the Odyssey² to produce custom sprite graphics on the fly. The hardware was designed with a set of **64 built-in characters** which could be used freely by the programmers, so "most Odyssey² games—particularly the early titles—utilize the built-in character set, giving the games a similar appearance" (Cassidy, 2008, p. 9). Another reason for similar-looking games was a limited color palette. While the Odyssey² was capable of **8 colors on screen**, its color palette of just **16 total colors** was no match for Atari's 128 colors. Without the Voice peripheral, the Odyssey²'s 1-channel of sound was also less capable than Atari's 2-channel sound chip.

HEAD-TO-HEAD

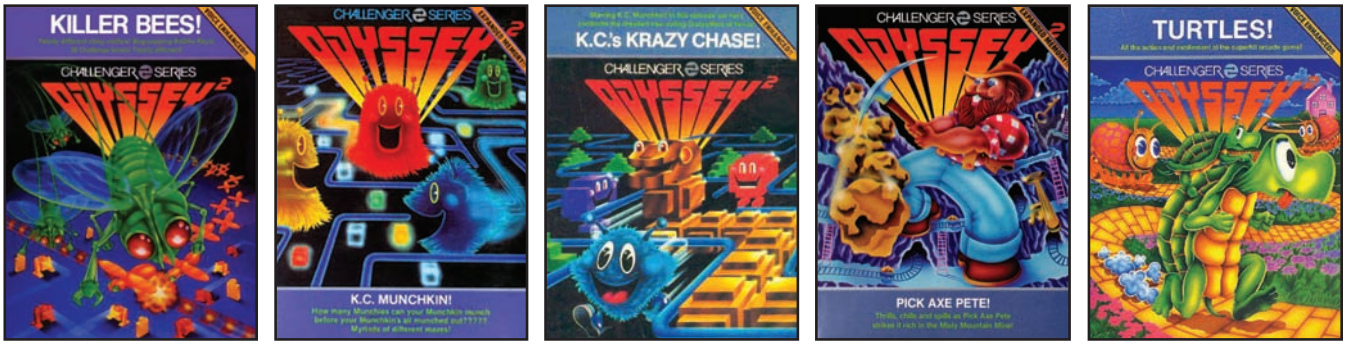
To compare the graphics and sound between the Odyssey² and Atari VCS, check out similar games released on each console (or watch video clips of them). Some popular games for comparisons include *Atlantis, Blockout* (Odyssey²) versus *Breakout* (VCS), *Demon Attack, Frogger, Popeye, Q*Bert*, and *Super Cobra*.

TABLE 3.5 Magnavox Odyssey² Tech Specs

Manufacturer:	Magnavox/Philips
Launch Price:	$179.99
Release Date:	Dec. 1978 (EU), Feb. 1979 (US), Sep. 1982 (JP)
Format:	Cartridge
CPU:	8-bit Intel 8048 processor (1.79 MHz)
Memory:	64 bytes RAM & 128 bytes Audio/Video RAM
Resolution:	160 × 200 pixels
Colors:	8 colors from a palette of 16
Sound:	1 channel mono

FIGURE 3.8 Magazine advertisement for the Magnavox Odyssey^2 from 1981 showing *The Quest for the Rings* title on the TV screen and its unique game board below the console.

FIGURE 3.9 Box art to five defining Odyssey² titles including from: (a) *Killer Bees!,* (b) *K.C. Munchkin!,* (c) *K.C.'s Krazy Chase!,* (d) *Pick Axe Pete!*, and (e) *Turtles!*.



(a) (b) (c) (d) (e)

■ KEY MAGNAVOX ODYSSEY² TITLES

Only "49 cartridges were released in the United States during Odyssey²'s initial production run. Some cartridges contained more than one game, so the total number of distinct, original U.S. games is closer to 60" (Cassidy, 2008, p. 9). There were also quite a few games that released exclusively in Europe and Brazil, such as *Air Battle, Chinese Logic, Depth Charge/Marksman, Frogger, Labyrinth Game/Supermind, Loony Balloon, Morse, The Mousing Cat, Neutron Star, Popeye, Q*bert, Secret of the Pharaohs*, and *Super Cobra* among others.

DID YOU KNOW?

In Europe, Odyssey² "Videopac" games released by Philips contained a number that preceded each game title (such as *5. Blackjack* and *10. Golf*). These numbers were added to create consistency and reduce confusion for games that otherwise appeared to have different titles because they were printed in multiple languages.

Many of the top titles for the Odyssey² were released late in the system's lifespan, between 1981 and 1983. Popular multiplatform titles worth checking out include *Atlantis* (1982), *Frogger* (1982), *Q*Bert* (1983), and *Turtles!* (1983). And although not all entirely original, the Odyssey² did have a number of fun exclusives, including *K.C. Munchkin!* (1981), *The Quest for the Rings* (1981) shown in Figure 3.8, *K.C.'s Krazy Chase!* (1982) seen in Figure 3.9, *Pick Axe Pete!* (1982), and *Killer Bees!* (1983).

■ MATTEL INTELLIVISION

Mattel was founded in 1945 by **Harold "Matt" Matson** and **Elliot Handler** as Mattel Creations. A sponsor of the *Mickey Mouse Club* TV series in 1955, the company introduced the *Barbie* doll in 1959, which became its best-selling toy. The following year Mattel released the talking doll *Chatty Cathy*, pioneering the "pull-string talking doll" industry that popularized the 1960s and 1970s. The company then purchased Ringling Bros. and Barnum & Bailey Circus for $40 million in 1971 (Langdon, 1980, para. 15) and launched Mattel Electronics in 1977 to produce electronic handheld games.

With its strong brand recognition and success in the handheld game business, Mattel entered the home video game market with the **Intellivision** (Figure 3.10), released nationwide in 1980 for $299.99. For its high price tag, consumers received the console, two permanently attached controllers, and the pack-in game *Las Vegas Poker & Blackjack*. Only a handful of titles were available at launch (see Table 3.6). Like Atari, Mattel manufactured a rebranded version of the system for Sears called the **Sears Super Video Arcade**, as well as a **TandyVision** model for Radio Shack stores.

The Intellivision controllers were innovative in that they contained a 12-button **numeric keypad** in which laminated **overlays** could be slid over for specific games. Its unique **directional disk** could be pressed as well as rotated, allowing for 16 directions of movement. Four action buttons completed the controller (two on each side); however, the top buttons functioned identically, so there were essentially three distinct action buttons.

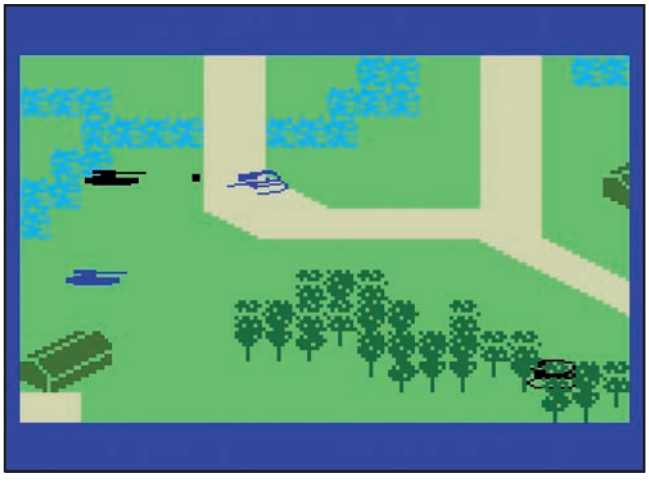
FIGURE 3.10 Mattel Intellivision with its controllers that could be stored inside the unit.

TABLE 3.6 Mattel Intellivision U.S. Launch Titles

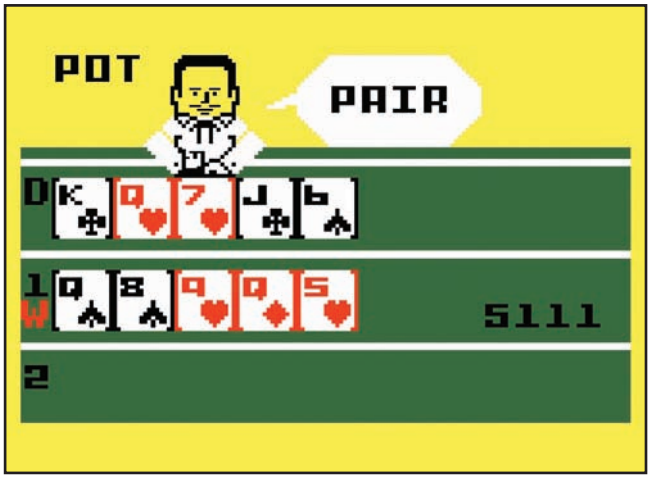
- ABPA Backgammon
- Armor Battle (Figure 3.11a)
- The Electric Company Math Fun
- Las Vegas Poker & Blackjack (Figure 3.11b)

Intellivision was the world's **first 16-bit** home video game system—and the industry would not see another 16-bit console until the fourth generation of video games in the late 1980s. Mattel is often credited for starting the first "**console war**" when it positioned the Intellivision to go head to head with the Atari VCS. It began in 1981 when "Mattel invested $6 million in a national ad campaign in direct competition to Atari that compared the graphic power of the Intellivision to the 2600. For the first time in gaming history, the media was whipped into a frenzy, predicting a bitter war between the two giants" (Slater, 2008, p. 15). Intellivision TV commercials featured well-known sports journalist **George Plimpton**

FIGURE 3.11 Intellivision launch titles (a) *Armor Battle* and (b) *Las Vegas Poker & Blackjack*.



(a)



(b)

FIGURE 3.12 Magazine advertisement for Intellivision with George Plimpton in 1981.

FIGURE 3.13 Failed peripherals: (a) Intellivision keyboard component and (b) Intellivoice adapter.

(a) (b)

(shown in Figure 3.12) using side-by-side comparisons to demonstrate Intellivision's superior graphics and sound capabilities over Atari's system. One of the slogans used in their ads was "The closest thing to the real thing."

Intellivision promotions also promised a **keyboard component** add-on unit (Figure 3.13a) in early advertisements, convincing many consumers they would be able to turn their system into a full-functioning home computer. Countless delays led to customer complaints and Mattel Electronics was eventually investigated by the Federal Trade Commission (FTC) for fraud and false advertising. A rumored 4,000 keyboard components were made but never received a national release. The units that were sold in test markets or mail order were recalled for technical issues and the product was officially canceled in the fall of 1982.

That same year Mattel released its **Intellivoice** (Figure 3.13b) add-on peripheral for around $100. Similar to The Voice peripheral on Odyssey^2, the Intellivoice adapter utilized a voice synthesizer to generate audible speech in certain games. The adapter plugged into the cartridge slot of the console and then games plugged into the Intellivoice. Only a handful of games ever utilized the Intellivoice peripheral and it was considered a market failure. A sleeker-looking **Intellivision II** was also released in 1982 with detachable controllers.

DID YOU KNOW?

The original Intellivision programming teams' identities and work location were kept a closely guarded secret to avoid the possibility of competitors snatching them away. Gabriel Baum, Don Daglow, Rick Levine, Mike Minkoff, and John Sohl went by the alias **Blue Sky Rangers**, named after their "Blue Sky" brainstorming sessions.

■ CONSOLE COMPARISON: INTELLIVISION VERSUS ATARI VCS AND ODYSSEY^2

Compared to the VCS and Odyssey^2, which ran at 1.19 MHz and 1.79 MHz respectively, the Intellivision's **894.89 kHz** CPU (Table 3.7) was relatively

TABLE 3.7 Mattel Intellivision Tech Specs

Manufacturer:	Mattel Electronics
Launch Price:	$299.99
Release Date:	1980 (US), 1981-82 (EU), 1982 (JP)
Format:	Cartridge
CPU:	16-bit General Instrument CP1610 (894.89 kHz)
Memory:	1456 bytes RAM & 7168 bytes ROM
Resolution:	192 × 160 pixels
Colors:	16 from a palette of 16
Sound:	3 channel mono

slow—clocking in at approximately half the speed of the Odyssey^2. On the other hand, being **16-bit** meant Intellivision could process more information, such as more on-screen objects. The Intellivision also surpassed the competition with its internal memory of **1456 bytes RAM** and **7168 bytes (7.168 KB) ROM**—compared to Atari's 128 bytes RAM and 4 KB ROM and Odyssey^2's 4 bytes RAM with 128 bytes A/V RAM. The console's **192 × 160** pixels screen resolution was about equal to Atari's 160 × 192 pixels and the 160 × 200 resolution of the Odyssey^2.

Like Odyssey^2, Intellivision only had a color palette of 16 colors to work with. However, it could display all **16 colors on screen**, compared to 8 on the Odyssey^2 and only 4 colors per scan line on the Atari VCS. Lastly, Intellivision came up ahead in the sound department with 3 channels of sound—compared to 2 channels on the VCS and only 1 channel sound on the Odyssey^2. Between Mattel and Atari, "Intellivision had a newer and more powerful CPU than VCS, slightly more memory, and played better-looking games" (Kent, 2001, p. 195). Intellivision may have had better graphics and sound, but the Atari VCS was more adept at handling action games due to its faster processor.

HEAD-TO-HEAD

To compare the graphics and sound between the Intellivision and VCS, try similar games released on each system (or view clips of them). Popular games to compare include *Night Stalker* (Intellivision) versus *Dark Cavern* (VCS), *NFL Football* (Intellivision) versus *Realsports Football* (VCS), *River Raid*, *Demon Attack*, and *BurgerTime*.

■ KEY INTELLIVISION TITLES

Intellivision may have been best known for its impressive lineup of sports titles. Mattel went out of their way to acquire licenses for every sports-related game they manufactured, "from the American Backgammon Players Association to the U.S. Chess Federation, to Major League Baseball" (Nilsen, 2001, p. 195). Beyond sports games, *Utopia* (1981) by **Don Daglow** is often regarded as one of the first city building/god games which helped pave the way for the real-time strategy genre.

For role-playing game fans, Intellivision was the only console to offer *Advanced Dungeons & Dragons* video games at that time. Several impressive exclusive titles on the system included Imagic's *Dracula* (1982), Activision's *Worm Whomper* (1983), and a late, unofficial sequel to *BurgerTime* (in Figure 3.14) called *Diner* in 1987.

While not nearly as deficient as the Odyssey^2, the Intellivision library did not contain as many licensed arcade titles compared to the VCS. Mattel eventually obtained arcade ports such as *Pac-Man* and *Donkey Kong*, but these came out many months after they had already been available on competing systems. Approximately 125 games were released for the Intellivision console, compared to well over 400 games on Atari's system.

■ COLECOVISION

Appearing late in what would eventually be known as the second generation of video games was Coleco's follow-up to its Telstar series—**ColecoVision** (Figure 3.15).

FIGURE 3.14 Box art to five popular Intellivision titles including from (a) *Lock 'N' Chase*, (b) *Astrosmash*, (c) *Night Stalker*, (d) *Bump 'n' Jump*, and (e) *BurgerTime*.

(a) (b) (c) (d) (e)

FIGURE 3.15 ColecoVision video game console with two joystick controllers.

Released in August of 1982, "ColecoVision generally sold for $195. By this time, Atari had cut the price of the VCS to $135" (Kent, 2001, p. 207). To compete with the pre-established consoles on the market, Coleco secured exclusive rights to reproduce Nintendo's arcade classic ***Donkey Kong*** game, including a tabletop version and a cartridge which came bundled with every ColecoVision system. Coleco maintained the rights to a home version of *Donkey Kong* beyond the holiday season and sold an estimated 500,000 by that Christmas (Businessweek, 1983, p. 31). Twelve games were available at launch, including a number of arcade ports such as Exidy's *Venture*, along with *Turbo* and *Zaxxon* by Sega (Table 3.8).

If the name "ColecoVision" didn't sound enough like "Intellivision," one look at the console and the influence is obvious. Not only did Coleco design the body of the system with spare room to store two controllers, but the controllers themselves were remarkably similar to Intellivision's. Aside from reversing the location of the directional stick, each controller included a 12-button **numeric keypad** that (like Intellivision's controller) could be fitted with plastic overlays. Coleco also followed Mattel's lead by placing action buttons on each side of the controllers.

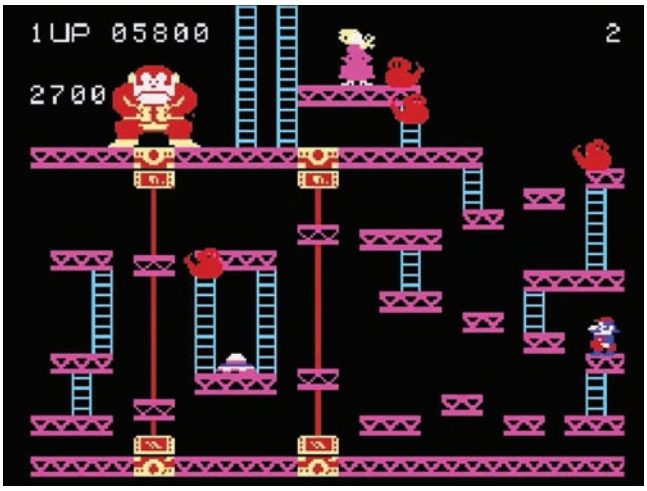
Atari had well over 100 VCS titles when ColecoVision launched in 1982. As a way to superficially inflate the number of games the ColecoVision could play (and possibly to give VCS owners a reason to replace their Atari systems with a ColecoVision), **Michael Katz** and his marketing team developed an adapter known as **Expansion Module #1**. This add-on peripheral (shown in Figure 3.17) allowed the ColecoVision to play almost all of Atari's VCS games—giving it the largest library of game titles at that time. Atari was unable to take legal action against Coleco since the VCS did not contain any patented parts.

The second ColecoVision peripheral called **Expansion Module #2** was a steering wheel (Figure 3.17) and gas pedal controller. The package came bundled with a port for Sega's popular *Turbo* arcade game and was compatible with a few other games. **Expansion Module #3** was a console that the ColecoVision system plugged directly into to create a piecemeal version of Coleco's **Adam computer**. The device included a separate keyboard, **digital data pack (DDP)** cassette

TABLE 3.8 ColecoVision U.S. Launch Titles

• Carnival	• Smurf: Rescue in Gargamel's Castle
• Cosmic Avenger	• Space Fury
• Donkey Kong (Figure 3.16a)	• Space Panic
• Ken Uston's Blackjack/Poker	• Turbo
• Lady Bug	• Venture
• Mouse Trap	• Zaxxon (Figure 3.16b)

FIGURE 3.16 Screenshots from ColecoVision U.S. launch titles (a) *Donkey Kong* and (b) *Zaxxon*.



(a)

(b)

drives, and a printer. Similar to Intellevision's computer add on, Expansion Module #3 suffered from production problems and like the standalone Adam computer—was considered a commercial failure.

Other peripherals included the **Roller Controller** trackball which came bundled with a *Centipede* clone called *Slither*, and the **Super Action Controller Set** (Figure 3.17) which included two fist-grip joysticks and the game *Super Action Baseball*. The top side of the Super Action controllers included a 12-function keypad, 8-direction joystick, and a two-directional dial called the "speed roller." The handle contained four action buttons mounted in the grip (one for each finger). Like the steering wheel, the Roller Controller and Super Action Controller Set were only compatible with a small number of titles.

■ CONSOLE COMPARISON: COLECOVISION VERSUS ATARI VCS AND INTELLIVISION

By the time ColecoVision was manufactured, "the price of technology had come down so much that Coleco could afford a chip with the **memory mapping** and **frame buffers** that Atari left out of Stella, the processing chip in the Video Computer System. These added features gave the ColecoVision smoother animation and more arcade-like graphics than the Intellivision and the VCS" (Kent, 2001, p. 206). Engineered by **Eric Bromley**, its top-of-the-line graphics could be credited to its **3.58 MHz Zilog Z80A** CPU by **NEC**, in addition to a **TMS9928A video display processor** by **Texas Instruments** (Table 3.9). Its Zilog Z80A ran twice as fast as the Intellivision processor and three times faster than the VCS.

FIGURE 3.17 ColecoVision VCS (a) adapter, (b) steering wheel, and (c) Super Action Controller.

(a)

(b)

(c)

TABLE 3.9 ColecoVision Tech Specs	
Manufacturer:	Coleco
Launch Price:	$195
Release Date:	August 1982
Format:	Cartridge
CPU:	8-bit NEC Zilog Z80 A (3.58 MHz)
Memory:	1 KB RAM, 16 KB Video RAM & 8 KB ROM
Resolution:	256 × 192 pixels
Colors:	16 colors from a palette of 16
Sound:	4 channel (3-tone, 1-noise) Texas Instr. SN76489AN

For internal memory, ColecoVision's **1 KB RAM** and **8 KB ROM** was about equal to Intellivision's 1.46 KB RAM and 7.17 KB ROM; however, its **16 KB Video RAM** gave its graphics an instantly recognizable edge. Atari's 128 bytes RAM and 4 KB ROM landed the VCS in a distant third place for memory. ColecoVision also led the pack in screen resolution with **256 × 192 pixels**—compared to Intellivision's 192 × 160 and Atari's 160 × 192 pixels. Color capability was a tie with Intellivision, featuring up to 16 on screen colors from a color palette of 16 colors.

ColecoVision's sound was superior to Intellivision and the Atari VCS with its **Texas Instruments SN76489AN** sound card generating 3 channels of tone and one for noise. In comparing the consoles' sound, ColecoVision games typically sounded richer and fuller, containing not only better sound—but more of it. Games that appeared on all three consoles sometimes contained musical scores that Mattel and Atari's games lacked altogether, such as in *Donkey Kong* and *Frogger*. Perhaps the biggest weakness of the ColecoVision was that most of its games took about 12 seconds to boot up.

HEAD-TO-HEAD

To compare the graphics and sound between the ColecoVision, Intellivision, and Atari VCS, check out games released on all three consoles (or watch video clips of them). Some popular games for comparisons include *Centipede, Donkey Kong, Frogger, Pitfall!, River Raid, Q*Bert*, and *Zaxxon*.

■ KEY COLECOVISION TITLES

One of the biggest challenges for ColecoVision in the beginning was that it did not have nearly as many games as its competitors who had been on the market for years.

FIGURE 3.18 Box art to five defining ColecoVision titles including from (a) *Turbo*, (b) *Antarctic Adventure*, (c) *Donkey Kong Junior*, (d) *Jumpman Junior*, and (e) *Venture*.

(a) (b) (c) (d) (e)

FIGURE 3.19 Two-page magazine advertisement for ColecoVision from 1982.

"Coleco did not have enough money to compete with Atari for big licenses, but Coleco's marketers had a knack for selecting small games with strong followings. Coleco secured licenses for *Mr. Do, Lady Bug, Cosmic Avenger*, and *Venture*" (Kent, 2001, p. 207). Other great arcade games included ports of Sega's *Turbo* and *Zaxxon*, Exidy's *Mouse Trap*, and *Antarctic Adventure* from Konami to name a few.

In addition to Konami and Sega, Coleco received a healthy amount of third-party support with multiple games from top publishers such as Activision, Epyx, Imagic, Parker Brothers, and Sierra Entertainment. One key title not to be overlooked was *Jumpman Jr.* from Epyx (in Figure 3.18). "It may not be the most jaw-dropping-looking ColecoVision title, but in terms of gameplay it's virtually unmatched and a must for platform fans" (McFerran, 2010, p. 99).

Approximately 145 cartridges were manufactured for the ColecoVision between 1982 and 1984 (Foster, 2005, p. 50). This did not include all the VCS games the system could play with the Expansion Module #1 adapter, which more than doubled that total amount. One interesting business strategy by Michael Katz and Coleco included manufacturing game cartridges for both the VCS and Intellivision—including *Donkey Kong* the year after it released on ColecoVision. Atarisoft also made a handful of games for the ColecoVision, including *Centipede, Defender, Galaxian*, and *Jungle Hunt.*

DID YOU KNOW?

Motion picture company Universal/MCA demanded royalties from Coleco and Nintendo—claiming *Donkey Kong* (seen in Figure 3.19) violated copyrights related to its *King Kong* movie. Nintendo disagreed and was sued by Universal in 1982. King Kong was over 40 years old, so the character was deemed public domain. Nintendo won the case.

■ ATARI 5200

The **Atari 5200** (Figure 3.20) was often marketed as the Atari 5200 "SuperSystem") released just three months after the ColecoVision in November of 1982 for a higher price tag of $269. The system was originally developed to compete with the Intellivision, but ultimately ended up in competition with the ColecoVision (Herman, 2003). In retrospect, the systems are considered part of the same generation; however, at that time the 5200 and ColecoVision were basically seen as sole competitors in a new phase of the video game market.

Under the hood, "the Atari 5200 had the same processor as the Atari 400 home computer" (Kent, 2001, p. 229) but retailed for much less. Around a dozen games had been produced for the system, but only four were available at launch, (Table 3.10) including the pack-in title *Super Breakout*. *Super Breakout* hit the arcades in 1978 and was ported to the VCS four years earlier, so it appeared quite dated compared to *Donkey Kong* on ColecoVision. Atari eventually replaced the game with *Pac-Man* as the title bundled with the console.

Game cartridges were nearly twice the size of VCS cartridges; however, the 5200 was not backward compatible with 2600 games. Instead, Atari marketed both consoles simultaneously, rebranding the VCS as the **Atari 2600**. Atari continued to support and manufacture games for the 2600, while the 5200 was seen as a more advanced alternative for serious gamers. A 2600 adapter (shown in Figure 3.22) was eventually released, but it only worked with newer versions of the 5200 console and lacked the VCS's color/black and white function.

TABLE 3.10 Atari 5200 U.S. Launch Titles

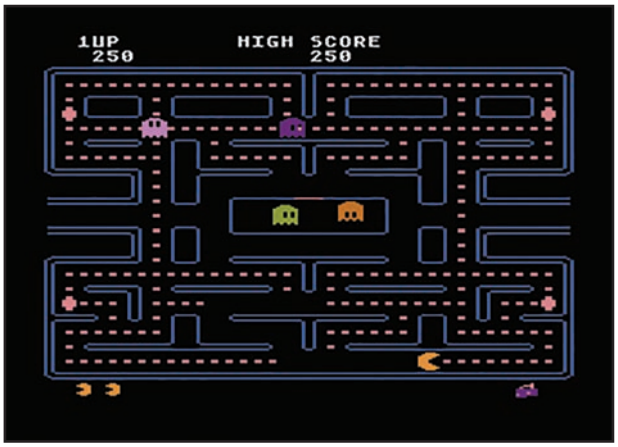
• Galaxian	• Space Invaders
• Pac-Man (Figure 3.21a)	• Super Breakout (Figure 3.21b)

There were several innovations the 5200 introduced to the home console market in 1982. In place of the manual TV/Game **radio frequency (RF) switch** of previous consoles, the 5200 included an **automatic switchbox** where the system would automatically switch from a regular TV signal to the game system signal when the console was turned on. The original 5200 model contained **four controller ports** (jacks), along with **start, pause,** and **reset** buttons on the controllers. Following in the footsteps of Intellivision and ColecoVision, the 5200 controller also came with a 12-button **numeric keypad** that **overlays** could be snapped on top of for certain games. It also featured four action buttons (two on each side) similar to the controllers for Intellivison.

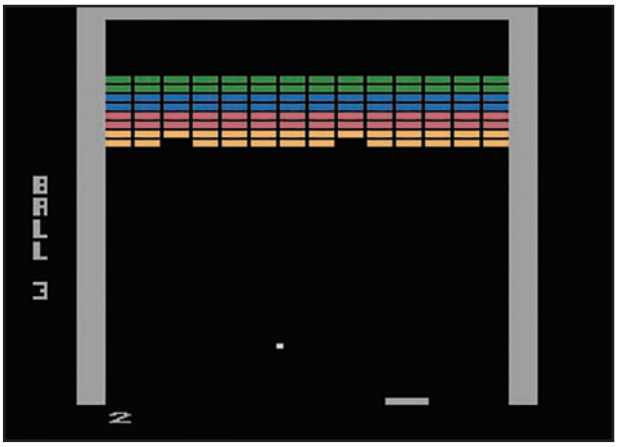
As state-of-the-art as these features were, the controllers themselves are often regarded as one of the biggest missteps of the 5200. The major problem was that the **360-degree joystick** did not center itself. This made playing most games much more difficult than necessary. Atari's engineering team was aware of this and even filed a petition to have the system dropped until new controllers were designed—however Ray Kassar ignored their request and moved forward with manufacturing (Kent, 2001, p. 229). An updated version of the console was released in 1983, but it did not address the joystick issue. Instead, the newer model was reduced to two controller ports instead of four and replaced the convenient, automatic

FIGURE 3.20 Atari 5200 with its four controller ports and joystick controller.

FIGURE 3.21 Screenshots from Atari 5200 U.S. launch titles (a) *Pac-Man* and (b) *Super Breakout*.



(a)



(b)

switchbox with a manual RF switch. At least a solid **Trak-Ball** controller was released for games like *Missile Command* and *Centipede*.

■ CONSOLE COMPARISON: ATARI 5200 VERSUS COLECOVISION

Atari's custom version of the MOS Technology 6502 (known as **SALLY**) had the ability to be halted in order for other devices to control the **bus** (data path). It also included multiple co-processors to assist the CPU. Two custom graphics chips included **ANTIC** (Alphanumeric Television Interface Controller) and **GTIA** (Graphic Television Interface Adaptor) (Table 3.11). The 5200's sound was driven by the 4 channel **POKEY** (Pot Keyboard Integrated Circuit) sound chip.

Compared to ColecoVision's specs, the 5200's **1.79 MHz** processor appears to be only half as fast as ColecoVision's 3.58 MHz Zilog Z80A CPU. However, while "the Z80 runs faster than the 6502,the latter can do more operations per clock cycle (effectively 2 to 1), so, they are more or less equal" (Molyneaux & Horton, 2016, para. 15).

The 5200's internal memory of **16 KB RAM** was comparable to ColecoVision's combined 1 KB and 16 KB Video RAM, but featured four times the ROM with 32 KB versus 8 KB for Coleco's system. Larger cartridge size didn't necessarily equal better graphics, but it did allow room for high quality sounds such as digitized speech to be included in Atari 5200 cartridges as heard in *Berzerk* and *RealSports Baseball* (1983). The 5200's **4 channel POKEY sound chip** produced excellent sound for its time and was about equal to the Texas Instruments SN76489AN sound card inside the ColecoVision.

Atari's system had a higher resolution at **320 × 192 pixels**, compared to 256 × 192 pixels on ColecoVision. Both consoles could display up to **16 colors** on screen, but the 5200 had the superior color palette with **256 colors** to choose from, compared to Coleco's 16 total colors. Each system handled colors and sprites differently, making a difficult comparison there—but overall the Atari 5200 was a slightly more powerful machine.

HEAD-TO-HEAD

To compare the graphics and sound between the Atari 5200 and ColecoVision, check out games released on each console (or watch clips of them). Some popular games to compare include *Congo Bongo, Frogger, Jungle Hunt, Mr. Do's Castle*, and *Pac-Man*.

TABLE 3.11 Atari 5200 Tech Specs

Manufacturer:	Atari, Inc.
Launch Price:	$269.99
Release Date:	November 1982
Format:	Cartridge
CPU:	8-bit MOS custom SALLY 6502C (1.79 MHz)
Memory:	16 KB RAM, 2 KB BIOS, 32 KB ROM window for games
Resolution:	320 × 192 pixels
Colors:	16 colors from a palette of 256
Sound:	4 channel sound POKEY chip

FIGURE 3.22 Magazine advertisement for the Atari 5200 and its peripherals from 1983.

■ KEY ATARI 5200 TITLES

A lot of the games released on the 5200 were simply upgraded versions of 2600 titles with better graphics and sound. Of course, the 5200 version of *Pac-Man* was leagues above the abysmal 2600 version, but other games only looked marginally better and many consumers weren't interested in repurchasing slightly enhanced updates of games they already owned. Well over half of the 69 games officially released for the 5200 were also available on the 2600. Notable titles that were clearly superior on the 5200 included *Missile Command* (1982), *Centipede* (1982) (Figure 3.22), *Defender* (1983), *Joust* (1983), *Realsports Baseball* (1983), *Gyruss* (1984), and *Pitfall II: Lost Caverns* (1984).

While the console did not have a lot of exclusive titles, it did receive the only home port of the Taito arcade game *Space Dungeon* (shown in Figure 3.23) in 1983. Like many older consoles, the 5200 had many interesting titles developed for it long after its initial lifespan. Games worth checking out that were released after the turn of the century include *Millipede* (2002), *Koffi: Yellow Kopter* (2002), *BurgerTime* clone *Beef Drop* (2004), *Adventure II* (2007), and *Sinistar* (2010).

■ VIDEO GAME CRASH OF 1983

The second generation video game market is well known for what is commonly referred to as the **North American Video Game Crash of 1983**. Total revenues from U.S. video arcades and the home video game market had grown to around $11.8 billion at its peak. This fell by approximately 97% by 1985 when the "console industry that was worth more than $3 billion on its own was estimated to have fallen to just $100 million" (Lambie, 2013, para. 2).

One of the main reasons the market crashed in North America was too many consoles (see Figure 3.24) and poorly made games flooding the market. Atari's *Pac-Man* and *E.T. The Extra-Terrestrial* were just the tip of the iceberg of countless poorly made games (often called "**shovelware**") by independent developers looking to get a piece of the pie. Third-party development was also a fairly new business back then, and hardware manufacturers like Atari had not yet developed a means for licensing and quality control. Other reasons for the crash included competition from home computers, as well as inflation.

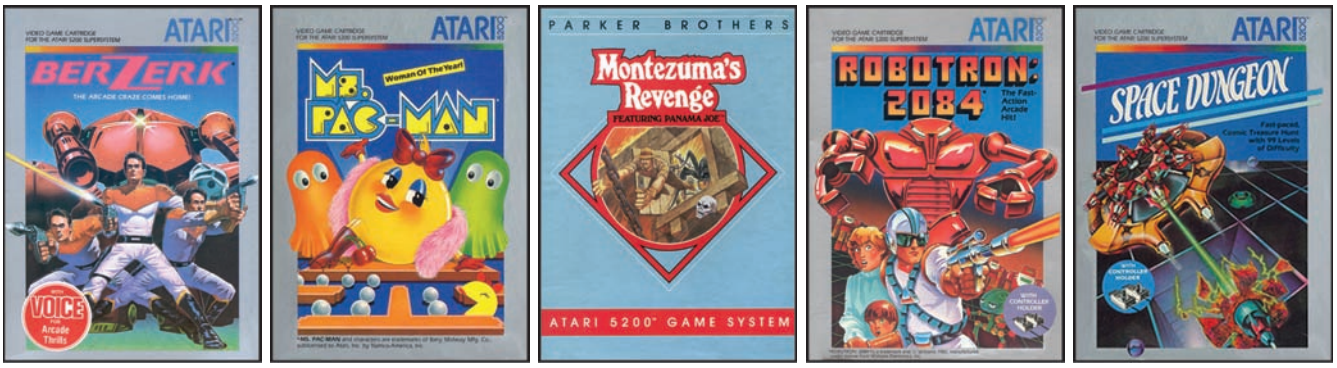
DID YOU KNOW?

The Fairchild Channel F was originally launched as the "**Video Entertainment System**" or **VES**, but was renamed the "Fairchild Channel F" when Atari released their similarly titled "VCS" the following year. **Vectrex** was the last system released in the second generation and came with its own monochrome **vector monitor**.

■ SECOND-GENERATION MARKET SUMMARY

As illustrated in Figure 3.25, the Atari VCS/2600 dominated the second generation by a landslide—eventually selling over 30 million units. Its success could be attributed to acquiring key arcade titles like *Space Invaders* and *Missile Command*, strong third-party

FIGURE 3.23 Box art to five defining Atari 5200 titles including from (a) *Berzerk*, (b) *Ms. Pac-Man*, (c) *Montezuma's Revenge*, (d) *Robotron: 2084*, and (e) *Space Dungeon*.



(a) (b) (c) (d) (e)

FIGURE 3.24 A look at the many less-popular consoles of the second generation.

Fair Channel VES/F
November 1976

1292 Advanced Programmble Video System 1976 (Europe)

RCA Studio II
January 1977

Bally Astrocade
October 1977–1978

APF Microcomputer System (MP1000) January 1978

Interton VC 4000
1978 (Germany)

Epoch Cassette Vision
July 1981 (Japan)

Emerson Arcadia 2001
1982

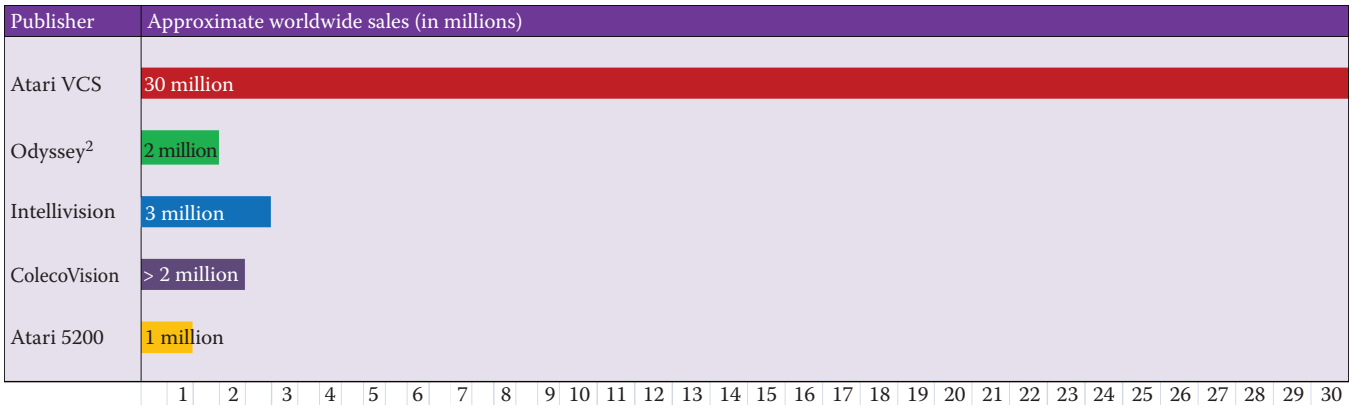
Vectrex
November 1982

support by companies like Activision, Imagic, and Parker Brothers, as well as plenty of support from Warner Communications—even after the release of the 5200. Ironically, it was Atari's poorly made licensed games, too many third-party and independent developers, along with supporting the 2600 simultaneously with the 5200 that contributed to the North American video game crash of 1983.

The Odyssey^2 sold moderately well in the United States and quite well in Europe and Brazil where it was marketed and branded under parent Dutch electronics company **Philips**. It was among the top three consoles leading into 1982, although a distant third after the Atari VCS/2600 and Mattel's Intellivision. "It boasted more CPU intelligence than the Atari 2600, but it lacked the licensed arcade titles and third-party developers to make it competitive over the long run" (Edwards, 2012, para. 17). As a matter of fact, no third-party game was even developed for the Odyssey^2 in the United States until Imagic's *Demon Attack* in 1983 (Katz & Kunkel, 1983, p. 40). By then the market had begun to crash, but not before over 1 million Odyssey^2 units were sold in the United States alone.

At one point, Intellivision captured approximately 20% of the market. And "despite being twice as expensive as the 2600, the Intellivision sold over 850,000 units [in 1981]. In what was to be Intellivision's finest hour in an industry [then] valued at $1.5 billion, Mattel announced a staggering $100,000,000 profit in 1982" (Slater, 2008, p. 15). When the market began to crash in 1983, Mattel sold Intellivision to Senior Vice President of Marketing **Terrence Valeski** who formed **Intellivision Inc.**

FIGURE 3.25 Second generation console sales graph.



(later **INTV Corporation**). While it did not win the console war with Atari, Intellivision was the only console of the second generation to be continuously manufactured and supported with new games well after the video game crash of 1983 (Robinson, 2003).

The last major consoles released in 1982 may have been the biggest victims of the video game crash. Mattel's ColecoVision sold well over 1 million units by mid-1983 (Johnson, 1983, para. 13) and more than 2 million units by the end of 1984. Between it and the 5200, the ColecoVision was the better selling system. However, with all its losses from the video game crash, Coleco officially dropped out of the home console market in October 1985. Had the market not crashed, Coleco may have remained a major player in the following generation of video games.

The Atari 5200 sold approximately 1 million units, but was never officially sold outside of North America. Besides its lack of original titles and abysmal, non-centering joysticks, the console's failure can also be attributed to Atari splitting its development and marketing resources between the 2600 and the 5200—rather than putting all its eggs in one basket. Between this, its failings with *Pac-Man* and *E.T.*, and an oversaturation of systems and games on the video game market, "by the end of 1983, Atari had racked up $536 million in losses. Warner Communications sold the company the following year" (Kent, 2001, p. 240). Stores began liquidating their inventory of games and consoles and many retailers discontinued the sale of video game systems altogether.

■ SECOND GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the second generation of video games. Here is a list of the top 10 features that defined the generation:

1. Microprocessor-driven game logic
2. Interchangeable ROM cartridges for an unlimited number of games
3. Computer simulated opponents (**artificial intelligence or AI**) for single-player games
4. 12-button numeric keypad controllers with game-specific overlays
5. Non-scrolling, single screen playfields (most games)
6. Multi-screen playfields spanning multiple screen areas (some games)
7. Blocky, simple sprites with screen resolutions up to 320 × 192 pixels
8. Color graphics, normally between 2 and 16 simultaneous colors on screen
9. Multiple audio channels (up to four)
10. Digitized speech in games like *P.T. Barnum's Acrobats* and *Berzerk*

■ ACTIVITY: FAILED CONSOLES REPORT AND PRESENTATION

Choose a second-generation console that sold less than 1 million units and develop a report and presentation on the history, business, and technology of that system. Be sure to include: (1) the publisher's goals, (2) how the system was marketed, (3) technical specifications and notable game titles, (4) why the system failed, and (5) [conclusion] what might have saved the console from its demise.

The report should contain three main points and a minimum of *two* quotes which are to be paraphrased or cited verbally in the speech. The recommended total presentation length is 3:30–4:30 minutes, not to exceed 5 minutes total.

CONSOLE SUGGESTIONS

Suggested consoles to report on include: Fairchild Channel VES/F (November 1976), 1292 Advanced Programmable Video System (1976, Europe), RCA Studio II (January 1977), Bally Astrocade (October 1977–1978), APF Microcomputer System [MP1000] (January 1978), Interton VC 4000 (1978, Germany), Epoch Cassette Vision (July 1981, Japan), Emerson Arcadia 2001 (1982), or Vectrex (November 1982).

■ CHAPTER 3 QUIZ

1. Part of the success of *Space Invaders* can be attributed to the popularity of:
   a. Asteroids
   b. Star Wars
   c. Star Trek
   d. Roswell

2. Credited as the first mascot and/or iconic arcade video game character:
   a. Daisy
   b. Pac-Man
   c. Donkey Kong
   d. Marios

3. The lead character in *Super Mario Bros.* first appeared in which game?
   a. *Popeye*
   b. *Mario Bros.*
   c. *Donkey Kong*
   d. *Defender*

4. The Atari 2600 was originally called the VCS, which stood for:
   a. Video Console System
   b. Vector Computer System
   c. Video Computer System
   d. Video Cartridge System

5. Who took over as the president & CEO of Atari Inc. in 1978?
   a. Ray Kassar
   b. Ralph Baer
   c. Willy Higinbotham
   d. Steve Russell

6. Upon leaving Atari, Nolan Bushnell bought back the rights and grew what franchise?
   a. Pizza Hut
   b. Ground Round
   c. Chuck E. Cheese's
   d. Dave and Busters

7. This company was the first independent developer and distributor of console games:
   a. Electronic Arts
   b. Intellivison
   c. Activision
   d. Nintendo

8. Often credited as the first video game to include an "Easter egg":
   a. Warren Robinett's *Adventure*
   b. Howard Scott Warshaw's *Raiders of the Lost Ark*
   c. Kazunori Sawano's *Galaxian*
   d. Toru Iwatani's *Pole Position*

9. Two poorly received games produced by Atari that damaged the company's reputation:
   a. *Space Invaders* and *Asteroids*
   b. *Asteroids* and *Pac-Man*
   c. *Defender* and *E.T.*
   d. *E.T.* and *Pac-Man*

10. Which second generation console included a full, 49-key computer keyboard and released a programming cartridge called Computer Intro!
    a. Fairchild F
    b. Atari VCS
    c. Oddessy²
    d. Intellivision

11. These consoles offered add-on peripherals that added speech effects to certain games:
    a. Atari VCS and Oddessy²
    b. Oddessy² and Intellivision
    c. Intellivision and ColecoVision
    d. ColecoVision and Atari 5200

12. This second-generation console was the world's first 16-bit home video game system:
    a. Atari VCS
    b. Odyssey²
    c. Intellivision
    d. ColecoVision

13. Which of the following consoles did not have controllers with 12-button numeric keypads?
    a. Odyssey²
    b. Intellivision
    c. ColecoVision
    d. Atari 5200

14. The well-known sports journalist hired for Intellivision's advertisements comparing their games to Atari's VCS games:
    a. Harold "Matt" Matson
    b. Elliot Handler
    c. George Plimpton
    d. George Harrison

15. The original Intellivision programming team members' whose identities and work location were kept a closely guarded secret became known as the:
    a. Blue Sky Rangers
    b. Red Hawks
    c. Intellivisionaries
    d. Programmers Undercover

16. One of this console's successes was securing exclusive rights to reproduce Nintendo's arcade classic *Donkey Kong* game and bundling it with every system:
    a. Odyssey²
    b. Intellivision
    c. ColecoVision
    d. Atari 5200

17. The first console to develop an adapter to play Atari VCS games:
    a. Odyssey²
    b. Intellivision
    c. ColecoVision
    d. Atari 5200

18. The original version of this console contained four controller ports (jacks), along with start, pause, and reset buttons on its controllers:
    a. Odyssey²
    b. Intellivision
    c. ColecoVision
    d. Atari 5200

19. In what year was the video game crash in the United States?
    a. 1978
    b. 1980
    c. 1983
    d. 1986

20. Which one of the following is *not* a cause of the video game crash?
    a. Floods of new consoles
    b. Renewed interest in going to the movies
    c. Growing number of home computers
    d. Poorly made games by smaller companies

True or False

21. Activision was formed by a group of underpaid, underappreciated Apple employees.

22. Only 49 cartridges were released in the United States during Odyssey²'s initial production run.

23. A sleeker version of the Intellivision called "Intellivision Plus" released in 1982.

24. Motion picture company Paramount/MCA demanded royalties from Coleco and Nintendo—claiming *Popeye* violated copyrights related to its intellectual property.

25. Vectrex was the last system released in the second generation and came with its own monochrome vector monitor.

■ FIGURES

FIGURE 3.1 Screenshots of defining arcade games from the Golden age: (a) *Space Invaders* (Taito, 1978), (b) *Galaxian* (Namco, 1979), (c) *Pac-Man* (Namco, 1980), and (d) *Donkey Kong* (Nintendo, 1981).

FIGURE 3.2 Atari VCS, often called "The Atari" with standard, digital joystick controller. (Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14517499. Retrieved from https://upload.wikimedia.org/wikipedia/commons/b/b9/Atari-2600-Wood-4Sw-Set.jpg. An Atari 2600 four-switch "wood veneer" version, dating from 1980 to 1982. Shown with standard joystick.)

FIGURE 3.3 Screenshots from Atari VCS launch titles (a) *Air-Sea Battle* (Atari, 1977) (b) *Combat*. (Courtesy of Atari, 1977.)

FIGURE 3.4 Magazine advertisement for the Atari Video Computer System in 1981. ("Ads - Missile Command". Retrieved from http://www.atarimania.com/game-atari-2600-vcs-missile-command_s6870.html and http://www.atarimania.com/pubs/hi_res/pub_no_comparing_2.jpg)

FIGURE 3.5 Box art to five of the best VCS titles including from: (a) *Adventure* (Atari, 1979), (b) *Space Invaders* (Atari, 1988), (c) *River Raid* (Activision, 1982), (d) *Yars' Revenge* (Atari, 1982), and (e) *Pitfall II: Lost Caverns* (Activision, 1983). (*Adventure*, courtesy of Atari, 1979; *Space Invaders*, courtesy of Atari, 1988; *River Raid*, courtesy of Activision, 1982; *Yars" Revenge*, courtesy of Atari, 1982; and *Pitfall II: Lost Caverns*, courtesy of Activision, 1983.)

FIGURE 3.6 Magnavox Odyssey² with built-in membrane keyboard and updated joysticks. (Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=17722734. Retrieved from https://upload.wikimedia.org/wikipedia/commons/2/2d/Magnavox-Odyssey-2-Console-Set.jpg. The Magnavox Odyssey², the 1978 follow up to original 1974 release of the Magnavox Odyssey. The console features two controllers that are wired directly into the system.)

FIGURE 3.7 Screenshots from Odyssey² U.S. launch titles (a) *Football!* (Magnavox, 1978) and (b) *Speedway!* (Courtesy of Magnavox, 1978.)

FIGURE 3.8 Magazine advertisement for the Magnavox Odyssey² from 1981 showing *The Quest for the Rings* (Magnavox, 1981) title on the TV monitor and its unique game board below. (From Benj Edwards, May 11, 2012. Available at http://www.vintagecomputing.com/index.php/tag/Magnavox and http://www.vintagecomputing.com/wp-content/images/retroscan/odyssey2_characters_large.jpg. Retro Scan of the Week. The Magnavox Odyssey 2, from *TIME*, November 2, 1981, p.24.)

FIGURE 3.9 Box art to five defining Odyssey² titles including from: (a) *Killer Bees!* (Magnavox, 1983), (b) *K.C. Munchkin!* (Magnavox, 1981), (c) *K.C.'s Krazy Chase!* (Magnavox, 1982), (d) *Pick Axe Pete!* (Magnavox, 1982), and (e) *Turtles!* (Magnavox, 1983). (*Killer Bees!*, courtesy of Magnavox, 1983; *K.C. Munchkin!*, courtesy of Magnavox, 1981; *K.C.'s Krazy Chase!*, courtesy of Magnavox, 1982; *Pick Axe Pete!*, courtesy of Magnavox, 1982; and *Turtles!*, courtesy of Magnavox, 1983.)

FIGURE 3.10 Mattel Intellivision with its unique controllers that could be stored on top. (Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=17891257. Retrieved from https://upload.wikimedia.org/wikipedia/commons/6/66/Intellivision-Console-Set.jpg. The Intellivision, a 2nd generation video game console released by Mattel in 1979.)

FIGURE 3.11 Intellivision launch titles (a) *Armor Battle* (Mattel, 1979) and (b) *Las Vegas Poker & Blackjack* (Mattel, 1979). (Courtesy of Mattel, 1979. Uploaded by Scott Decker. Retrieved from http://www.scottdecker.com/video_games/intellivision_armor_battle_screen_2.jpg and http://www.scottdecker.com/video_games/intellivision_las_vegas_poker_and_blackjack.html)

FIGURE 3.12 Magazine advertisement for Intellivision with George Plimpton in 1981. (Retrieved from http://www.intellivisionbrasil.com/.%5Cimagens%5Cadvertising%5CIntellivision-Atari5.jpg)

FIGURE 3.13 Failed peripherals: (a) Intellivision keyboard component and (b) Intellivoice adapter. ((a) "Skel" (Derek McDonald). Sources of research: Wikipedia, The Dot Eaters, Emperor Multimedia Electronic Archives. Retrieved from http://www.old-computers.com/museum/description/mattel/intellivision/component-keyboard_s.jpg. (b) Courtesy of Evan-Amos - own work, CC BY-SA 3.0. Retrieved from https://commons.wikimedia.org/w/index.php?curid=18874849)

FIGURE 3.14 Box art to five popular Intellivision titles including from: (a) *Lock 'N' Chase* (Mattel, 1982), (b) *Astrosmash* (Mattel, 1981), (c) *Night Stalker* (Mattel, 1982), (d) *Bump 'n' Jump* (Mattel, 1983), and (e) *BurgerTime* (Mattel, 1982). (*Lock 'N'* Chase courtesy of Mattel, 1982; *Astrosmash* courtesy of Mattel, 1981; *Night Stalker* courtesy of Mattel, 1982; *Bump 'n' Jump* courtesy of Mattel, 1983; and *BurgerTime* courtesy of Mattel, 1982.)

FIGURE 3.15 ColecoVision video game console with two joystick controllers. (Courtesy of Evan-Amos - own work, public domain, "A ColecoVision unit". Available at https://commons.wikimedia.org/w/index.php?curid=11421149. Retrieved from https://upload.wikimedia.org/wikipedia/commons/4/4b/ColecoVision-wController-L.jpg)

FIGURE 3.16 Screenshots from ColecoVision U.S. launch titles (a) *Donkey Kong* (Coleco, 1982) and (b) *Zaxxon* (Coleco, 1982). (Courtesy of Coleco, 1982.)

FIGURE 3.17 ColecoVision VCS (a) adapter, (b) steering wheel, and (c) Super Action controller. ((a) Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34985653. Retrieved from https://en.wikipedia.org/wiki/ColecoVision#/media/File:ColecoVision-ExpMod1-Attached.jpg. The Expansion Module #1 allowed the ColecoVision to play any game from the Atari 2600. (b) Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34986721. Retrieved from https://en.wikipedia.org/wiki/ColecoVision#/media/File:ColecoVision-Expansion2.jpg. The Expansion Module #2 was a steering wheel for racing games. (c) Retrieved from http://cvaddict.com/images/articles/colecovision-super-action-controller.png and modified by Wardyga.)

FIGURE 3.18 Box art to five defining ColecoVision titles including from: (a) *Turbo* (Coleco, 1982), (b) *Antarctic Adventure* (Konami, 1984), (c) *Donkey Kong Junior* (Coleco, 1983), (d) *Jumpman Junior* (Epyx, 1983), and (e) *Venture* (Coleco, 1982). (*Turbo* courtesy of Coleco, 1982; *Antarctic Adventure* courtesy of Konami, 1984; *Donkey Kong Junior* courtesy of Coleco, 1983; *Jumpman Junior* courtesy of Epyx, 1983; and *Venture* courtesy of Coleco, 1982.)

FIGURE 3.19 Two-page magazine advertisement for ColecoVision from 1982. (Scanned and touched up by Wardyga.)

FIGURE 3.20 Atari 5200 with its four controller ports and joystick controller. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=35179017. Retrieved from https://upload.wikimedia.org/wikipedia/commons/a/a0/Atari-5200-4-Port-wController-L.jpg)

FIGURE 3.21 Screenshots from Atari 5200 U.S. launch titles *Pac-Man* (Atari, 1982). (Retrieved from http://www.atarimania.com/5200/screens/super_breakout_3.gif and http://www.atarimania.com/5200/screens/pacman_3.gif)

FIGURE 3.22 Magazine advertisement for the Atari 5200 and its peripherals from 1983. (Retrieved from http://www.atarimania.com/pubs/hi_res/pub_here_s_what.jpg)

FIGURE 3.23 Box art to five defining Atari 5200 titles including from: (a) *Berzerk* (Atari, 1983), (b) *Ms. Pac Man* (Atari, 1983), (c) *Montezuma's Revenge: Featuring Panama Joe* (Parker Brothers, 1983), (d) *Robotron: 2084* (Atari, 1983), (e) and *Space Dungeon* (Atari, 1983). (*Berzerk* courtesy of Atari, 1983; *Ms. Pac Man* courtesy of Atari, 1983; *Montezuma's Revenge: Featuring Panama Joe* courtesy of Parker Brothers, 1983; *Robotron: 2084* courtesy of Atari, 1983; and *Space Dungeon* courtesy of Atari, 1983.)

FIGURE 3.24 A look at the many less-popular consoles of the second generation. (Courtesy of Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18291554 Retrieved from https://upload.wikimedia.org/wikipedia/commons/3/34/Fairchild-Channel-F.jpg "The Acetronic MPU 1000, a video game console that was a part of the 1292 Advanced Programmable Video System family." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18312810 Retrieved from https://upload.wikimedia.org/wikipedia/commons/8/88/Acetronic-MPU-1000.png "The RCA Studio II, a video game console by RCA introduced in 1977." By Evan-Amos - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=38826714 Retrieved from https://upload.wikimedia.org/wikipedia/commons/c/c1/RCA-Studio-II-FL.jpg "The Bally Professional Arcade, one of the many names of a 2nd generation video game console released by Bally in the late '70s and early '80s." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18260687 Retrieved from https://upload.wikimedia.org/wikipedia/commons/5/5d/Bally-Arcade-Console.jpg "The APF MP1000 (some are also labeled the M1000), a video game console released by APF Electronics in 1978." By Evan-Amos - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=45579767 Retrieved from https://upload.wikimedia.org/wikipedia/commons/8/83/APF-MP1000-FL.jpg "The VC 4000 with controller. A second-generation video game console released in Germany by Interton Electronics." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?

curid=18298292 Retrieved from https://upload.wikimedia.org/wikipedia/commons/3/39/VC-4000-Console-Set.jpg "The Epoch Cassette Vision, a second generation video game console released only in Japan in 1981." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18364041 Retrieved from https://upload.wikimedia.org/wikipedia/commons/d/db/Epoch-Cassette-Vision-Console.jpg "The Emerson Arcadia 2001, a 2nd generation video game console released in 1982." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=17891484 Retrieved from https://upload.wikimedia.org/wikipedia/commons/7/77/Emerson-Arcadia-2001.jpg "The Vectrex video game console, shown with controller." By Evan-Amos - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=17735830. Retrieved from https://upload.wikimedia.org/wikipedia/commons/7/7a/Vectrex-Console-Set.jpg. The Fairchild Channel F with hard-wired controllers. A second-generation video game console released in 1976.)

FIGURE 3.25 Second generation console sales graph. (Designed by Wardyga using data from various public sources.)

Pro File: Nolan Bushnell Photo credit: By Tech Cocktail Flickr: Tech Cocktail Week: Sessions Speaker Series Downtown Vegas sponsored by Moveline, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=31557628

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Early PC Gaming

OBJECTIVES

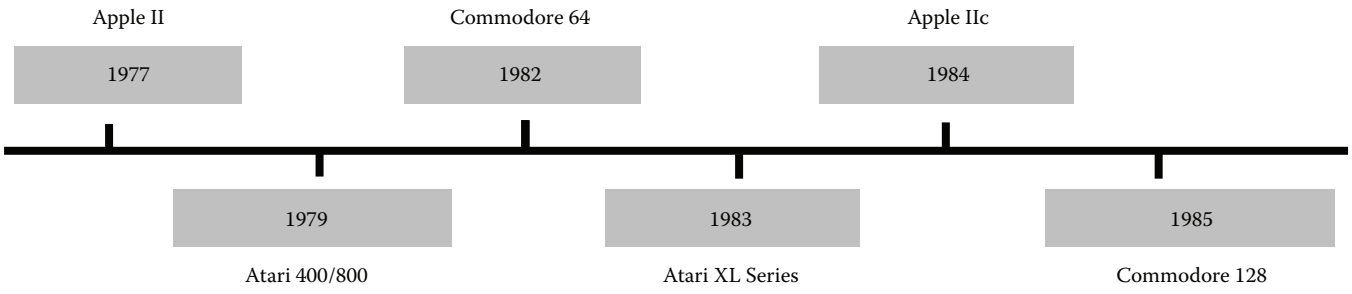
After reading this chapter, you should be able to:

- Provide an overview of the history of early Apple, Atari, and Commodore PCs.
- Have a sense of graphics and other capabilities of early home computer games.
- Compare early home computer games across PC platforms and gaming consoles.
- Be familiar with the technological differences among popular home computers.
- List some of the key video game titles and peripherals for each computer.
- Recognize the importance early PC technology had on the video game industry.
- Describe why each PC was unique to the growth of the home computer market.
- Illustrate how each of the early gaming computers evolved with updated models.
- Explain why Commodore 64 was the bestselling early PC for gaming in the United States.
- List several innovations introduced to gaming during this time period.
- Summarize early home computer market sales.

■ KEY TERMS AND PEOPLE

Amiga
ANTIC
Apple Computer/I
Apple II/II+
Apple IIc
Apple IIe
Apple IIGS
Apple III
Apple Lisa
ASIC
Atari XL series
Atari 400/800
Atari 8-bit family
BASIC
Bell & Howell
City-building games
Civilization series
Commodore 128
Commodore 16
Commodore 64
Commodore International
Commodore PET
Commodore Plus/4
Controller ports
Control Program/Monitor
Central Processing Unit
Will Crowther
CTIA (later GTIA)
Data Cassette Storage
Disk II
Disk Operating System (DOS)
Educator 64
Electronic Arts
Falling block puzzle games
Richard Garriott
God games
Graphical adventure game
Graphical MUD
Trip Hawkins
Rod Holt
I/O (input and output)
Steve Jobs
Macintosh 128K
Sid Meier
MMORPG
Peter Molyneux
Mockingboard
Multi-color sprites
Multi-User Dungeon (MUD)
Open-ended games
Alexey Pajitnov
POKEY
RAM (Random Access Memory)
Role-playing game (RPG)
Read-Only Memory (ROM)
SID 6581
SimCity series
Sound card
Teleprinter
Tetris series
Text adventure games
Toggle circuit
Jack Tramiel
Ultima series
VIC-20
VisiCalc
Ken and Roberta Williams
Steve "Woz" Wozniak
Will Wright
XE Game System (XEGS)
Bob Yannes
Zilog Z80

■ EARLY COMPUTER TIMELINE (APPLE, ATARI, AND COMMODORE)



■ INTRODUCTION

This chapter reviews the early days of personal computers and the games made popular by the technology. It includes detailed coverage of the early three breakthrough home computers for gaming by Apple, Atari, and Commodore. The evolution of the technology will also be discussed, including the people behind the scenes and the popular titles synonymous with computer gaming during this period. Coverage of this chapter spans the PC market before and throughout the third generation of console gaming.

■ APPLE I AND II

While working for Atari, **Steve "Woz" Wozniak** and **Steve Jobs** formed the **Apple Computer Company** in 1976 to sell Wozniak's original **Apple Computer** (later known as the Apple Computer 1, Apple I, or Apple-1). The Apple I was a well-designed circuit board (see Figure 4.1) that required users to provide their own cabinet, power supply, keyboard, and video monitor (Dunfield, 2007, para. 1). This meant added costs to the $666.66 launch price, in addition to its users needing to be fairly tech savvy to assemble everything. While the hardware may have been complex, the Apple Computer utilized **BASIC (Beginner's All-purpose Symbolic Instruction Code)** computer language which was designed to be easy to use. BASIC also allowed computer games to be programmed and played on the Apple.

DID YOU KNOW?

"Although the final pricing for the Apple I was $666.66, Jobs originally wanted to sell it for $777.77. Woz insisted that this price was too high, so he agreed to sell it for $666. When he was asked why he picked this number (the mark of Satan) he answered that he just took a lucky number, 7, and subtracted one" (Mesa, 2016, para. 3–4).

Steve Jobs was responsible for the marketing and sales of the computers and approximately 200 units were produced—with most of them sold during a span of nine or ten months (Williams & Moore, 1984, p. A67). Wozniak handled the customer support side of the business and it didn't take long to realize they would need to manufacture a more consumer-friendly model of the Apple for mass market appeal. During the following year, the computer received a refined design with an enclosed cabinet casing designed by Jobs, as well as a keyboard and a power supply developed by **Rod Holt**. The cabinet contained user-friendly connection ports for consumers to attach video monitors, cassette tape storage, and an eventual 5.25" floppy disk drive.

The newly remodeled Apple Computer was released as the **Apple II** (Figures 4.2 and 4.3). Now widely recognized as the system that launched the personal computer business (Kent, 2001, p. 71), the Apple II was one of the first microcomputers to be accessible to the home consumer. It was also the first commercial PC to include built-in color graphics capabilities with a palette of 16 fixed colors, as well as sound output and paddle controllers. The computer initially used the then-popular **data cassette storage** to save data. A year later, Apple introduced an external 5¼-inch floppy disk drive, called the **Disk II** (shown in Figure 4.2). The Disk II (created by Wozniak) is regarded as an engineering masterpiece for its economic use of electronic components (Freiberger & Swaine, 1985, p. 45).

Wozniak's work on the Apple II pioneered many industry standards for microcomputers, most notably with its inclusion of standard **input and output(I/O)** devices such as its keyboard and connector ports for a monitor and storage devices. Prior to the Apple II, microcomputers either had very limited I/O capability or no built-in user interface whatsoever. These older "mainframes" and "minicomputers" required external **teleprinters** (electromechanical typewriters), as well as screens. Together, these external devices could easily cost more than the price of the actual computer.

The Apple II did not contain a dedicated sound chip. Instead it used a **toggle circuit** capable of emitting "clicks" through a built-in speaker or line output jack. Sounds were generated exclusively by the software which clicked the speaker at specific times to produce simple beeps and pops—which in succession could produce basic music.

■ COMPUTER VERSUS CONSOLE COMPARISON: APPLE II VERSUS ATARI VCS (2600)

A low end Apple II cost more than six times the price of an Atari VCS/2600, but could do much more than just play video games. But for the consumer mainly interested in video games at that time, how did these two machines compare? Technically, the Apple II contained the same **1.023 MHz** 8-bit MOS Technology 6502 **CPU**

FIGURE 4.1 Apple Computer advertisement from *Interface Age* magazine, Oct. 1976.

Apple Introduces the First Low Cost Microcomputer System with a Video Terminal and 8K Bytes of RAM on a Single PC Card.

The Apple Computer. A truly complete microcomputer system on a single PC board. Based on the MOS Technology 6502 microprocessor, the Apple also has a built-in video terminal and sockets for 8K bytes of on-board RAM memory. With the addition of a keyboard and video monitor, you'll have an extremely powerful computer system that can be used for anything from developing programs to playing games or running BASIC.

Combining the computer, video terminal and dynamic memory on a single board has resulted in a large reduction in chip count, which means more reliability and lowered cost. Since the Apple comes fully assembled, tested & burned-in and has a complete power supply on-board, initial set-up is essentially "hassle free" and you can be running within minutes. At $666.66 (including 4K bytes RAM!) it opens many new possibilities for users and systems manufacturers.

You Don't Need an Expensive Teletype.

Using the built-in video terminal and keyboard interface, you avoid all the expense, noise and maintenance associated with a teletype. And the Apple video terminal is six times faster than a teletype, which means more throughput and less waiting. The Apple connects directly to a video monitor (or home TV with an inexpensive RF modulator) and displays 960 easy to read characters in 24 rows of 40 characters per line with automatic scrolling. The video display section contains its own 1K bytes of memory, so all the RAM memory is available for user programs. And the Keyboard Interface lets you use almost any ASCII-encoded keyboard.

The Apple Computer makes it possible for many people with limited budgets to step up to a video terminal as an I/O device for their computer.

No More Switches, No More Lights.

Compared to switches and LED's, a video terminal can display vast amounts of information simultaneously. The Apple video terminal can display the contents of 192 memory locations at once on the screen. And the firmware in PROMS enables you to enter, display and debug programs (all in hex) from the keyboard, rendering a front panel unnecessary. The firmware also allows your programs to print characters on the display, and since you'll be looking at letters and numbers instead of just LED's, the door is open to all kinds of alphanumeric software (i.e., Games and BASIC).

8K Bytes RAM in 16 Chips!

The Apple Computer uses the new 16-pin 4K dynamic memory chips. They are faster and take ¼ the space and power of even the low power 2102's (the memory chip that everyone else uses). That means 8K bytes in sixteen chips. It also means no more 28 amp power supplies.

The system is fully expandable to 65K via an edge connector which carries both the address and data busses, power supplies and all timing signals. All dynamic memory refreshing for both on and off-board memory is done automatically. Also, the Apple Computer can be upgraded to use the 16K chips when they become available. That's 32K bytes on-board RAM in 16 IC's—the equivalent of 256 2102's!

A Little Cassette Board That Works!

Unlike many other cassette boards on the marketplace, ours works every time. It plugs directly into the upright connector on the main board and stands only 2" tall. And since it is very fast (1500 bits per second), you can read or write 4K bytes in about 20 seconds. All timing is done in software, which results in crystal-controlled accuracy and uniformity from unit to unit.

Unlike some other cassette interfaces which require an expensive tape recorder, the Apple Cassette Interface works reliably with almost any audio-grade cassette recorder.

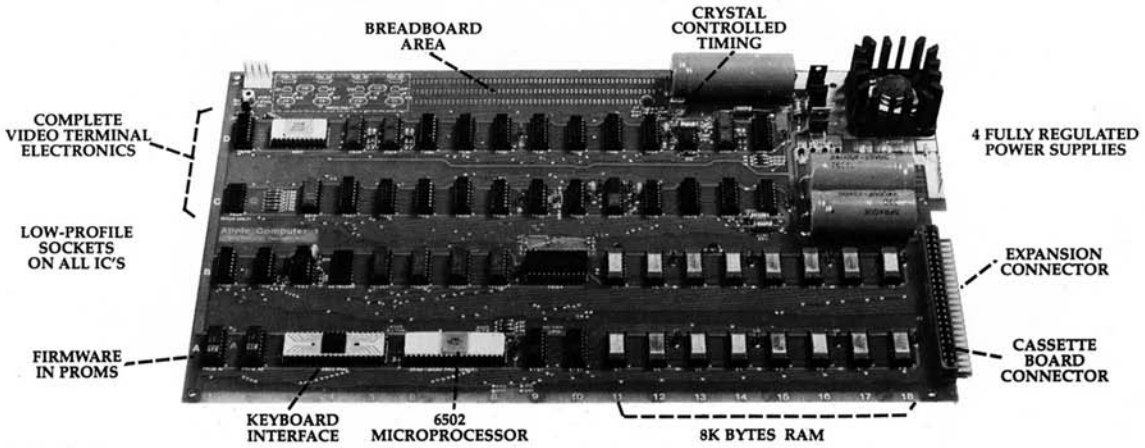
Software:

A tape of **APPLE BASIC** is included free with the Cassette Interface. Apple Basic features immediate error messages and fast execution, and lets you program in a higher level language immediately and without added cost. Also available **now** are a dis-assembler and many games, with many software packages, (including a macro assembler) in the works. And since our philosophy is to provide software for our machines free or at minimal cost, you won't be continually paying for access to this growing software library.

The Apple Computer is in stock at almost all major computer stores. (If your local computer store doesn't carry our products, encourage them or write us direct). **Dealer inquiries invited.**

Byte into an Apple $666.66*

* includes 4K bytes RAM



APPLE Computer Company • 770 Welch Rd., Palo Alto, CA 94304 • (415) 326-4248

OCTOBER 1976 CIRCLE NO. 7 ON INQUIRY CARD INTERFACE AGE 11

FIGURE 4.2 The Apple II (1977) with two Disk II floppy disk drives and a 1980s-era Apple Monitor II (a) and the Apple II Plus (1979) (b) without peripherals.

(a)

(b)

(central processing unit) as the Apple I (Table 4.1), which launched the same year as the Atari VCS in 1977. The VCS ran on an 8-bit MOS 6507 processor at a slightly faster 1.19 MHz.

Beyond processor speed, the units were quite different when comparing **RAM (random access memory)** and screen resolution. The Apple II could utilize **4 KB (kilobytes)** of expandable memory versus the Atari VCS's mere 128 bytes of RAM and **4 KBROM (Read-Only Memory)**. The Apple II displayed a higher horizontal screen resolution of **280 × 192 pixels** (screen dots) for 6-color games, compared to the VCS's resolution of 160 × 192 pixels for games displaying 4 colors per scan line. See Figure 4.4 for examples of the Apple II's graphics and text display capabilities.

TABLE 4.1 Apple II Tech Specs

Manufacturer:	Apple Computer, Inc.
Launch Price:	$1,298 w/4 KB RAM, $2,638 w/48 KB $598 w/4 KB board only
Release Date:	April 1977
Format:	Cassette Tape or 5.25" floppy disk (launched in 1978)
CPU:	8-bit MOS technology 6502 (1.023 MHz)
Memory:	4 KB–48 KB (3 banks of 4 KB or 16 KB RAM)
Resolution:	280 × 192 or 40 × 48 pixels (text = 40 characters × 24 lines)
Colors:	4–16 onscreen colors from a palette of 16
Sound:	No sound card; software sent "clicks" to built-in speaker

While graphically competent for its time, the Apple II's biggest weakness may have been its sound. Its software-driven sounds were often comparable to the beeps and noises output from Atari's 2 channel mono sound card. And since the use of sound seriously taxed the Apple's CPU, many games used sound sparingly. Eventually **sound cards** were developed for the Apple II, such as the **Mockingboard** by Sweet Micro Systems which could produce six audio voices and speech synthesis.

HEAD-TO-HEAD

To compare the graphics and sound between the Apple II and Atari VCS, play games released on both systems (or watch video clips of them). Some games to compare include *Frogger, Jungle Hunt, Ms. Pac-Man, Pitfall II: Lost Caverns*, and *Tapper*.

FIGURE 4.3 Magazine advertisement for the Apple II computer in 1978.

How to buy a personal computer.

Suddenly everyone is talking about personal computers. Are you ready for one? The best way to find out is to read Apple Computer's "Consumer Guide to Personal Computing." It will answer your unanswered questions and show you how useful and how much fun personal computers can be. And it will help you choose a computer that meets your personal needs.

Who uses personal computers.

Thousands of people have already discovered the Apple computer—businessmen, students, hobbyists. They're using their Apples for financial management, complex problem solving—and just plain fun.

You can use your Apple to analyze the stock market, manage your personal finances, control your home environment, and to invent an unlimited number of sound and action video games. That's just the beginning.

What to look for.

Once you've unlocked the power of the personal computer, you'll be using your Apple in ways you never dreamed of. That's when the capabilities of the computer you buy will really count. You don't want to be limited by the availability of pre-programmed cartridges. You'll want a computer, like Apple, that you can also program yourself. You don't want to settle for a black and white display. You'll want a computer, like Apple, that can turn any color tv into a dazzling array of color graphics.* The more you learn about computers, the more your imagination will demand. So you'll want a computer that can grow with you as your skill and experience with computers grows. Apple's the one.

How to get one.

The quickest way is to get a free copy of the Consumer Guide to Personal Computing. Get yours by calling 800/538-9696. Or by writing us. Then visit your local Apple dealer. We'll give you his name and address when you call.

*Apple II plugs into any standard TV using an inexpensive modulator (not included).

apple computer™

In California, call 800/662-9238.

CIRCLE NO. 26 ON FREE INFORMATION CARD

FIGURE 4.4 Screenshots of early Apple II titles: (a) *The Oregon Trail* (1978), (b) *Lemonade Stand* (1979), and (c) *Zork I: The Great Underground Empire* (1980).

(a) (b) (c)

■ KEY APPLE II TITLES

Many action and arcade games were developed for the Apple II, but the games that most differentiated the computer from the home console were **text adventure games**. Also known as "interactive fiction," this genre of games was pioneered by **Will Crowther**'s *Colossal Cave Adventure* (1976) (Figure 4.5a) which he programmed for the PDP-10 mainframe computer. Early text adventure games consisted of just text—where the player would control a character by inputting simple text commands such as "climb" or "take." Similar games appeared on the Apple II such as *Adventureland* (1978) and *Zork I* (1980).

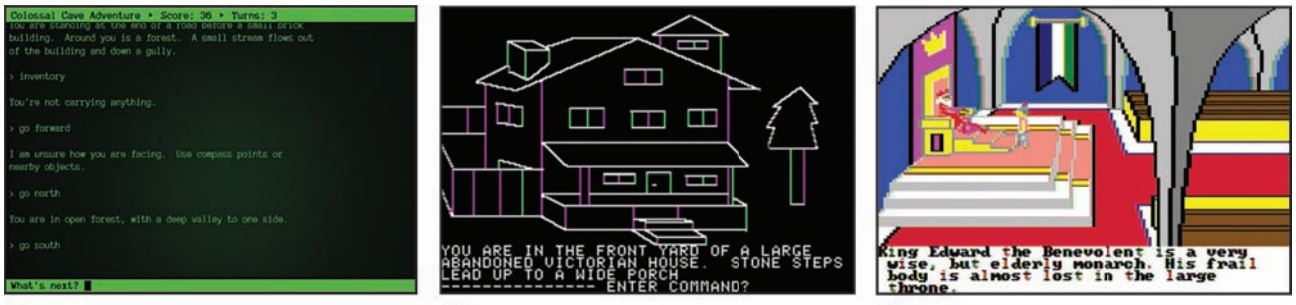
The very first **graphical adventure game** was *Mystery House* (1980) (Figure 4.5b) by **Ken and Roberta Williams** of On-Line Systems (now Sierra Entertainment). Ken was a programmer at IBM and Roberta was the visionary behind writing and designing pictures to accompany the text. "While its simple line graphics were visually primitive in comparison to games released just a few years later on the platform, *Mystery House* established an important precedent" (Barton & Loguidice, 2016, p. 5). The company would go on to develop *King's Quest* (Figure 4.5c), further revolutionizing the graphic adventure game genre with more detailed illustrations and animation.

Another genre that was conceived during this time was the **Multi-User Dungeon (MUD)**. Coined by **Roy Trubshaw** in 1978, early MUDs were text-based adventures that took place in a multiplayer, real-time virtual world. Influenced by the fantasy tabletop **role-playing game (RPG) Dungeons & Dragons**, MUDs combined features such as player versus player, interactive fiction, and online chat. Like graphic text adventures, **graphical MUDs** eventually emerged, such as Lucasfilm's *Habitat* (1985).

■ ELECTRONIC ARTS

Trip Hawkins was the Director of Strategy and Marketing at Apple Computer in 1982 when he left the company to incorporate video game publisher **Electronic Arts (EA)**. Aside from becoming one of the largest video game publishers in the world, EA made several important contributions to the business early on.

FIGURE 4.5 Evolution of the adventure game: Screenshots: (a) *Colossal Cave Adventure* (1976), (b) *Mystery House* (1980), and (c) *King's Quest* (1984).



(a) (b) (c)

FIGURE 4.6 Box art to five defining Apple II titles: (a) *The Bard's Tale*, (b) *Pinball Construction Set*, (c) *The Oregon Trail*, (d) *Karateka*, and (e) *Ultima I: The First Age of Darkness*.

(a) (b) (c) (d) (e)

First, the company was notable for promoting its game designers and programmers by including their name or picture on the box and/or in the game's literature. Second, the artwork for each game was extremely important to Hawkins. He believed the packaging for games should be attractive and similar to an album cover. Early Electronic Arts games such as *Pinball Construction Set* (1983) (in Figure 4.6) "were packaged in unique gatefold sleeves, with the designer's names on the front and an elegant graphic design that gave them the hip appearance of rock albums" (Fleming, 2016, p. 2). A third major achievement by EA was that it was first video game publisher to license athletes for video games beginning with *One on One: Dr. J vs. Larry Bird* (1983). This pioneered the practice of involving celebrities in the business of video games.

■ APPLE II SUCCESSORS

Two years after the introduction of the Apple II, the **Apple II+** was released in 1979. This update "included 48 KB RAM, six-color display, and a new BASIC from Microsoft, which established critical base specifications for the computer line" (Barton & Loguidice, 2014, p. 27). Apple also authorized electronics company **Bell & Howell** to manufacture a black Apple II+ which was targeted toward the education industry.

A year later came the release of the **Apple III** which was targeted toward businesses. The Apple III utilized 128–512 KB of RAM, enhanced audio, and came with the program **Apple III Business BASIC**. The computer had a rough start when technical problems led to a recall of the first 14,000 units. Combined with a high price tag of $4,340 to $7,800 USD, the Apple III only sold approximately 65,000–75,000 units and is generally considered a market failure (Linzmayer, 2004, pp. 41–43).

Abandoning all references to the Apple III, the next computer by Apple released in 1983 under the title **Apple IIe**. The "e" stood for "enhanced," since the Apple IIe came bundled with many features that were previously only available as upgrades or add-on peripherals. Codenamed "Diana" and "Super II," the computer included 64 KB RAM (upgradable up to 1 MB) and a custom **ASIC (Application-specific integrated circuit) chip**, which reduced the size and cost of the motherboard. Debuting at $1,395, the Apple IIe eventually came bundled with **DOS (Disk Operating System)**. DOS operated by using the command line and was the cutting-edge operating system (OS) for its time since it ran directly from an internal hard disk. The Apple IIe was manufactured and sold for over a decade, becoming Apple's most successful Apple II series computer.

That same year, Apple introduced another business computer known as the **Apple Lisa** for $9,995. The Lisa included a 5 MB hard drive and a faster processor, but after several revisions and price drops, the Lisa was a commercial failure. Part of the Lisa's downfall may have been due to the **Macintosh 128 K** which released in 1984 for $2,495. The 128 K was the original **Macintosh** branded personal computer, which would eventually become the main line of computers from Apple.

PRO FILE

STEVE WOZNIAK

KEY FACTS:

Co-founded Apple Inc. with Steve Jobs

Pioneered the personal computer revolution with the Apple I and II

PRO FILE

HISTORY:

- Born: August 11, 1950, San Jose, California

EDUCATION:

- BS in Electrical Engineering and Computer Science, University of California, Berkeley, 1987

CAREER HIGHLIGHTS:

- Designed calculators for Hewlett-Packard in 1971
- Created a circuit board for Atari's Breakout in 1973
- Designed the hardware, circuit board, and operating system for the Apple I in 1976
- Built the Apple II in 1977, which was among the first successful mass-produced PCs and the first w/color graphics and built-in BASIC programming language

RECOGNITION:

- ACM Grace Murray Hopper Award (1979), National Medal of Technology (1985), National Inventors Hall of Fame (2000), 7th Annual Heinz Award for Technology (2001), Isaac Asimov Science Award (2011), 66th Hoover Medal (2014), 2015 Alumnus of the Year Award, Legacy for Children Award (2015), and many more

Other subsequent models included the 1984 **Apple IIc** which contained 128 KB RAM, as well as a built-in 5.25" floppy drive. The "c" stood for "compact" as the Apple IIc was basically a complete system except for the separate display and power supply. In 1986 "Apple released the 16-bit **Apple IIGS**, the true backwards compatible successor to the original 8-bit II-series of computers. Although Apple was built on the back of the II-series, within a few years the Macintosh [computer line] began to receive most of the company's attention and resources" (Barton & Loguidice, 2016, p. 5).

■ ATARI 8-BIT FAMILY: 400 AND 800

Riding high on the success of the Atari 2600, Atari was well aware that the computer age was coming and its brand was a natural fit for this growing technology. Known as the **"Atari 8-bit family"** computer series, the **Atari 400** and **Atari 800** (Figure 4.7) launched in November of 1979 for $595 and $999, respectively. Management often called the 400 model "Candy" and the 800 model "Colleen," named after two attractive Atari secretaries (Fulton, 2008, p. 4). The official numbered titles for the systems were meant to reflect their RAM—with the 400 originally planned to ship with 4 KB of RAM and the 800 shipping with 8 KB—but falling memory costs allowed Atari to release both computers with at least 8 KB of RAM.

DID YOU KNOW?

"Atari's home computers were first to use special custom processors for graphics and device input/output, which freed up the main CPU for other tasks, a concept used by developers Jay Miner and Joe Decuir" (Retro Gamer, 2010, p. 142).

TABLE 4.2 Atari 400/800 Tech Specs

Manufacturer:	Atari, Inc.
Launch Price:	$549.95 (Atari 400), $999.95 (Atari 800)
Release Date:	November 1979
Format:	Cassette tape or 5.25" floppy disk + cartridge slot(s)
CPU:	8-bit MOS Technology "Rockwell" 6502 (1.79 MHz)
Memory:	8–16 KB RAM (400), 48 KB RAM (800)
Resolution:	320 × 192 monochrome or 160 × 96 in color (text = 40 × 24)
Colors:	4–16 onscreen colors from a palette of 128 or 256
Sound:	4× oscillators with noise mixing or 2× AM digital

Essentially, "the 400 was the little brother to the 800. It had a membrane keyboard (to protect against spills from the children who were its target market) and less expansion capability" (Klein, 2014, p. 1). The 400 was also more heavily marketed as a game machine. Each unit had a flip up top that housed a cartridge slot (two slots for the 800) and both computers had four **controller ports (jacks)** that were fully compatible with all Atari VCS/2600 joysticks and paddles. These ports could be used for a variety of functions, such as hard drive interfaces, modems, robot arms, and even a science kit by Atari that could measure light, sound, and temperature.

■ COMPUTER COMPARISON: ATARI 8-BIT VERSUS APPLE II

Both the Apple II and Atari 800 could utilize up to 48 KB of RAM and while each computer ran on

FIGURE 4.7 Atari (a) 400 and (b) 800 computer systems.

(a)

(b)

FIGURE 4.8 Screenshots of Atari 8-bit family titles: (a) *Rainbow Walker* (1983), (b) *Bounty Bob Strikes Back* (1984), and (c) *Rescue on Fractalus!* (1984).

(a) (b) (c)

a MOS 6502 processor (Table 4.2), the Atari 8-bit processor was faster at **1.79 MHz** versus Apple II which ran at 1.023 MHz. "Both Atari 400 and Atari 800 have multiple purpose co-processors for sound and graphics to take the load off of the 6502 CPU called **ANTIC**, **CTIA** (later **GTIA**) and **POKEY**" (Bogdan, 2014 p. 79). The POKEY co-processor handled the computer's sound and produced the best sound quality in home computers up to that time. Each system could run up to 16 colors onscreen; however, Atari computers had a much larger color palette to choose from, providing a wider variety to the overall look of their games as seen in Figures 4.8. The Apple II really only bested the Atari computers in resolution with a color resolution of 280 × 192 versus Atari's **160 × 96**. Being graphically superior to the Apple II helped Atari computers develop a reputation for games, but there were far fewer business applications compared to the Apple II.

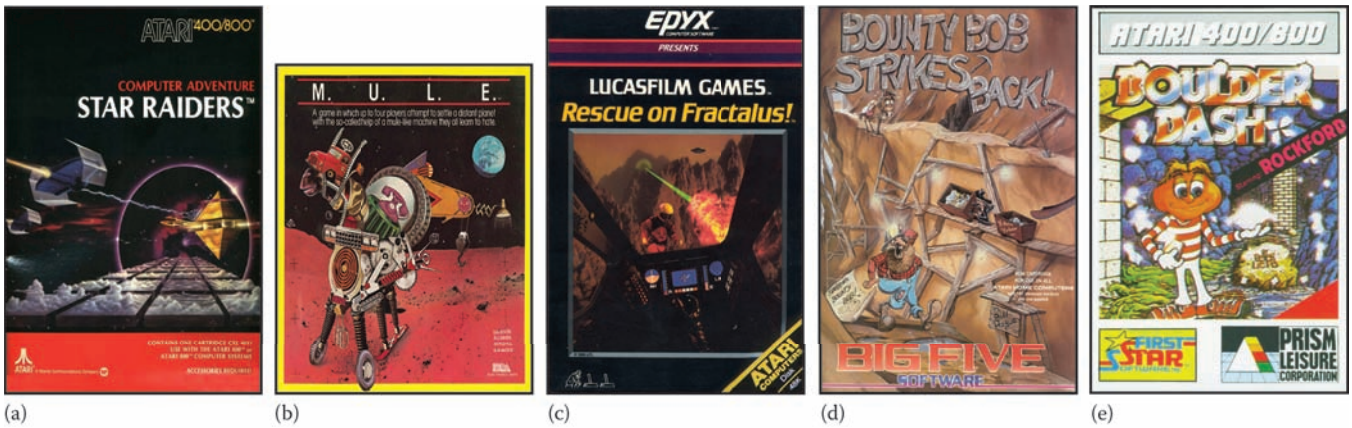
HEAD-TO-HEAD

To compare the graphics and sound between the Apple II and the Atari 8-bit, play (or research video clips) of games released on both computer systems. Some interesting titles to compare include *B.C.'s Quest for Tires, Donkey Kong, Galaxian, Karateka*, and *Pitfall II: Lost Caverns*.

■ KEY ATARI 8-BIT TITLES

Atari computer games were known for their distinct "graphics look" native to Atari software, including "multiple graphics modes, four directional fine scrolling, [and] colorful modified character-set backgrounds (Stanton, Wells, Rochowansky, Mellid, & Michael, 1984, p. 14). *Star Raiders* (1979) (in Figure 4.9) was one of its earliest titles and remained one of the reasons many gamers purchased an Atari computer for many years.

FIGURE 4.9 Box art to five defining Atari 8-bit family games: (a) *Star Raiders*, (b) *M.U.L.E.*, (c) *Bounty Bob Strikes Back*, (d) *Rescue on Fractalus!*, and (e) *Boulder Dash*.



(a) (b) (c) (d) (e)

FIGURE 4.10 Magazine advertisement for the Atari 800 computer in 1981.

Atari 8-bit computers had the definitive version of *M.U.L.E.* (1983), which utilized all four joystick ports permitting four-player simultaneous play. For those who owned extra paddles, up to eight players could play together in *Super Breakout* (1979). See Figure 4.10 for more.

Despite its virtues, the 400 and 800 were complicated and expensive computers to build and did not prove very profitable for Atari. The 400 especially had a difficult time competing with technically superior machines appearing in the early 1980s, which typically included more RAM and improved keyboards. Beginning in 1983, Atari would roll out a new generation of 8-bit computers with its **XL series**.

■ EXTENDED FAMILY: ATARI 8-BIT SUCCESSORS

In 1983, Atari launched numerous successors to the 400 and 800 computers (Figure 4.11), beginning with the ill-fated **1200XL**. The 1200XL launched at $899 and featured 64 KB of RAM. Due to performance issues such as poor design and backward compatibility problems with previous Atari systems, the 1200XL was discontinued after less than six months in June 1983. It was quickly replaced by the **600XL** and **800XL**.

Aside from improving the design and functionality of the units, Atari's goal for the 600XL and 800XL was to again offer consumers two options at different price points. The 600XL launched at $199 with 16 KB of RAM, while the 800XL shipped for $299 and 64 KB of memory. The 800XL would go on to become Atari's most popular computer of all time.

Following the "XL series," Atari released an "XE series" in 1985 with the **65XE** and **130XE**. The "XE" stood for "XL-Expanded" since the computers contained 64 KB and 128 KB of RAM, respectively. Like the 400 and 800, the XE PCs were given numbers to represent their memory (e.g., the 130XE contained 130,000 bytes of RAM). Beyond additional memory, the XE series was not a substantial improvement over the XL series, with much of its inner technology identical to previous iterations of XL computers. On top of that, the keyboards had a mushy feeling to them and the white keys would get dirty quickly (RetroIsle, 2015, para. 8).

Atari's final 8-bit release before moving on to its **ST** computer series was the **XE Game System (XEGS)** in 1987. Essentially a repackaged 65XE with a detachable keyboard, the XEGS was compatible with practically all Atari 8-bit software. A basic and deluxe set was offered, with the deluxe set including a joystick, keyboard, light gun, and two additional games.

FIGURE 4.11 Evolution of the Atari 8-bit computers (a) 1200XL, (b) 600XL, (c) 800XL, (d) 130XE, and (e) 65XE Game System.

■ COMMODORE 64

Commodore International was founded in Toronto by **Jack Tramiel** (pronounced Tra-mel) in 1954 as a

FIGURE 4.12 Commodore 64 home computer system.

typewriter assembly plant. The company expanded to a calculator manufacturing plant in 1969, and in 1976 Tramiel purchased CPU manufacturer **MOS Technology** for $800,000 (Kent, 2001, p. 248). MOS Technology made the 6502-microprocessor chip used by the Apple II, Atari 400 and 800, as well as Commodore's first home computer, the **Commodore PET (Personal Electronic Transactor)** which launched in 1977. Years later Commodore released a "family" version of the PET, the **VIC-20** computer in 1981. The VIC-20 followed Tramiel's motto for building computers "for the masses, not the classes" and retailed for just $299.95. It was the first computer to retail below $300 and became the first computer to sell more than 1 million units. Tramiel's business model of producing fully functional computers at an affordable price continued with the **Commodore 64** (Figure 4.12) which launched in August 1982 for just $595.

The Commodore 64 was named after its 64 KB of RAM. Its retail price of $595 (see Figure 4.13) for 64 KB of RAM was a bargain compared to the Apple II's initial price of $2,638 and Atari 800's launch price of $999.95—and those computers only included 48 KB of RAM. In part from acquiring MOS Technology, Tramiel was able to keep the price of the C64 down by manufacturing many of the computer's parts in-house. Another move that set the Commodore 64 apart from the competition was following in Atari's footsteps by marketing and selling the C64 in retail stores such as Sears, Roebuck and Company.

■ COMPUTER COMPARISON: COMMODORE 64 VERSUS ATARI 8-BIT

With 20% more RAM at a fraction of the cost of an Atari 800, how did the Commodore 64 hold up in other technical areas? Its screen resolution of **320 × 200 pixels** (Table 4.3) was progressively higher than the Apple II's 280 × 192 display and slightly better than the Atari 800's 320 × 192. Its improved processing chip allowed for **multi-color sprites** (two colors per screen dot versus one on the other PCs) which made it "easier to create fast-moving, flicker-free game graphics" (Reimer, 2005, p. 4).

TABLE 4.3 Commodore 64 Tech Specs

Manufacturer:	Commodore International, Ltd.
Launch Price:	$595
Release Date:	August 1982
Format:	Cassette tape or 5.25" floppy disk
CPU:	8-bit MOS Technology 6510 (1.023 MHz)
Memory:	64 KB RAM + 20 KB ROM
Resolution:	320 × 200 pixels (text = 40 characters × 25 lines)
Colors:	16 onscreen colors from a palette of 16
Sound:	3 channel SID 6581 (Sound Interface Device) chip

FIGURE 4.13 Magazine advertisement for the Commodore 64 computer in 1982.

WHEN WE ANNOUNCED THE COMMODORE 64 FOR $595, OUR COMPETITORS SAID WE COULDN'T DO IT.

THAT'S BECAUSE THEY COULDN'T DO IT.

The reason is that, unlike our competitors, we make our own IC chips. *Plus* all the parts of the computer they go into.

So Commodore can get more advanced computers to market sooner than anybody else. And we can get them there for a lot less money.

WHAT PRICE POWER?

For your $595,* the Commodore 64™ gives you a built-in user memory of 64K. This is hundreds of dollars less than computers of comparable power.

Lest you think that the Commodore 64 is some stripped-down loss leader, a look at its available peripherals and interfaces will quickly convince you otherwise.

SOFTWARE THAT WORKS HARD.

The supply of software for the Commodore 64 will be extensive. And with the optional plug-in Z80 microprocessor, the Commodore 64 can accommodate the enormous amount of software available in CP/M®.

Add in the number of programs available in BASIC and you'll find that there are virtually no applications, from word processing to spreadsheets, that the Commodore 64 can't handle with the greatest of ease.

PERIPHERALS WITH VISION.

The Commodore 64 interfaces with all the peripherals you could want for total personal computing: disk drives, printers and a telephone modem that's about $100, including a free hour's access to some of the more popular computer information services. Including Commodore's own Information Network for users.

RUN YOUR BUSINESS BY DAY.
SAVE THE EARTH BY NIGHT.

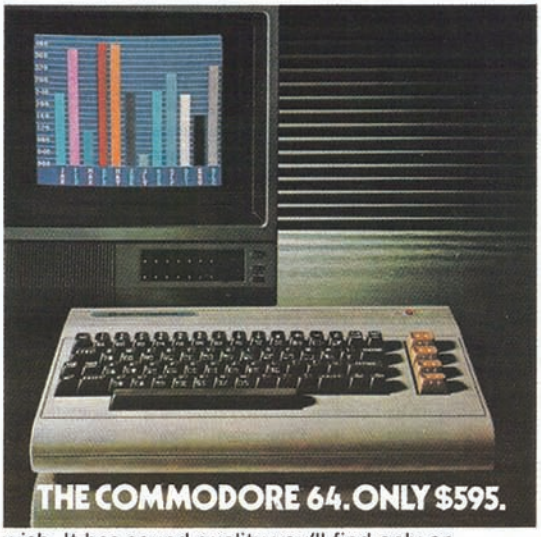
At the end of a business day, the Commodore 64 can go into your briefcase and ride home with you for an evening's fun and games.

Because of its superior video quality (320x200 pixel resolution, 16 available colors and 3D Sprite graphics), the Commodore 64 surpasses the best of the video game machines on the market. Yet, because it's such a powerful computer, it allows you to invent game programs that a game machine will never be able to play; as well as enjoy Commodore's own video game cartridges.

ATTACK, DECAY, SUSTAIN, RELEASE.

If you're a musicologist, you already know what an ADSR (attack, decay, sustain, release) envelope is. If you're not, you can learn this and much more about music with the Commodore 64's music synthesizing features.

It's a full-scale compositional tool. Besides a programmable ADSR envelope generator, it has 3 voices (each with a 9-octave range) and 4 waveforms for truly sophisticated composition and playback—through your home audio system, if you



wish. It has sound quality you'll find only on separate, music-only synthesizers. And graphics and storage ability you won't find on any separate synthesizer.

DON'T WAIT.

The predictable effect of advanced technology is that it produces less expensive, more capable products the longer you wait.

If you've been waiting for this to happen to personal computers, your wait is over.

See the Commodore 64 soon at your local Commodore Computer dealer and compare it with the best the competition has to offer.

You can bet that's what the competition will be doing.

Commodore Business Machines
Personal Systems Division
P.O. Box 500, Conshohocken, Pennsylvania 19428

Please send me more information on the Commodore 64™

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Zip_____ Phone_____

commodore COMPUTER

SI0221

*Manufacturer's Suggested Retail Price: July 1, 1982. Disk drives and printers are not included in prices. The 64's price may change without notice.
CP/M® is a registered trademark of Digital Research, Inc. Canada–3370 Pharmacy Avenue, Agincourt, Ontario, Canada M1W 2K4.

FIGURE 4.14 Screenshots of early Commodore 64 titles: (a) *Choplifter* (1982), (b) *Spy Hunter* (1983), and (c) *Impossible Mission* (1984).

(a) (b) (c)

On the flip side, its paltry color palette of 16 colors (see Figure 4.14) paled in comparison to the 8-bit Atari computers' hundreds of colors. Furthermore, the Atari computers had a faster CPU, which was evident when comparing games like *Dropzone* and *Rescue on Fractalus!*. Generally speaking, C64 games looked and played more smoothly, while Atari's computer games had more vivid color. Sound was another story, however, as the C64's 3 channel **SID 6581 (Sound Interface Device)** processor by **Bob Yannes** was superior to all home computer sound chips preceding it.

HEAD-TO-HEAD

To compare the graphics and sound between the Apple II, Atari 400/800, and the Commodore 64, play (or watch video clips) of games that were released on all three computers. Some games to compare include *Choplifter, Spy Hunter, Summer Games, World Karate Championship*, and *Zaxxon*.

■ KEY COMMODORE 64 TITLES

Partly due to its hardware capabilities and large game library, the Commodore 64 developed a reputation as a gaming computer more than a business PC. It could play games on cassette tapes, floppy disks, and cartridges, although most of its games were manufactured on tape or cartridge. Impressive third-party cartridge-based games included "*Gyruss* from Parker Bros, *Diamond Mine* by Roklan, *Moondust* by Creative, *Maze Master* by HES and *Jumpman Junior* by Epyx" (Retro Gamer, 2009, p. 57).

Memorable cassette titles included Mastertronic's *Master of Magic, One Man and His Droid*, and *Spellbound* to name a few. Other hits included *Boulder Dash, The Sentinel, Archon*, and *Elite;* the *Ultima* and *Bard's Tale* role-playing game series; and graphical adventure games *Maniac Mansion* and *Zak McKracken* by LucasArts. Microprose and Cinemaware also produced classics like *Sid Meier's Pirates!* and *Defender of the Crown*. Commodore created a few notable first-party

FIGURE 4.15 Box art to five defining Commodore 64 titles: (a) *IK+, Zack McKracken and the Alien Mindbenders*, (b) *Impossible Mission, Turrican II*, and (c) *Paradroid*.

(a) (b) (c) (d) (e)

titles, including *International Soccer* and an excellent conversion of the arcade hit *Wizard of War*. The C64 had a small number of exclusive titles, but most of its top games were multiplatform as seen in Figure 4.15.

DID YOU KNOW?

Partly due to their expensive cost (the Commodore 1541 floppy disk drive debuted at $400), "even at the peak of its popularity, it's said that only around 10% of all C64 owners had a disk drive" (Retro Gamer, 2009, p. 57).

■ COMMODORE 64 SUCCESSORS

Commodore released several successors to the C64, including the **Educator 64** in 1983 and the **SX-64** in 1984. The Educator 64 was targeted toward schools as a replacement for its older PET computers. While it looked like a PET on the outside (using PET casing), its inside contained a C64 motherboard. The Educator 64 included a green monochromatic monitor. Since most C64 games were in color, it did not sell very well.

The SX-64 (also known as the **Executive 64**) was an all-in-one portable version of the Commodore 64 and included both a built-in 5-inch monitor and 1541 floppy disk drive. Released in 1984, this briefcase-size bundle was the first portable color computer on the market and debuted at $995. A unique feature of the SX-64 was that its handle doubled as a stand, which could be rotated to position the angle of the monitor.

Another pair of computers to be released after the Commodore 64 included the **Commodore 16** and the **Commodore Plus/4** which both released in 1984. The $99 Commodore 16 came with 16 KB of RAM and "was designed to replace the Commodore VIC-20, but it was not compatible with the VIC-20, nor with the C64" (Personal Computer Museum. 2016, para. 1). The Commodore Plus/4 contained mostly the same technical specifications as the Commodore 16, with four times the RAM and a price tag of $299. While these PCs could display more onscreen colors than the Commodore 64, they lacked other features such as hardware sprites and the SID sound processor. Better suited for office programs like word processing and spreadsheet applications, these units did not catch on with gamers and were considered market failures.

The last of Commodore's early 8-bit computers was the **Commodore 128**. Debuting in January 1985 for $299, the C128 came with 128 KB of RAM and contained multiple processors. The inclusion of a **Zilog Z80 CPU** allowed the C128 to run the more powerful **Control Program/Monitor (CP/M)** operating system. It was also nearly completely backward compatible with C64 games—one of the best computers of the 8-bit generation. However, the 16-bit generation was just around the corner and gamers would soon be shifting their attention to Commodore's **Amiga** line of computers. See Table 4.4 for summary these and other important computers between 1979 and 1988.

■ GENRE PIONEERS

Many genres emerged on the early PC landscape. England's **Richard Garriott** (known as alter ego "Lord/General British" in his games) created the ***Ultima*** series (Figure 4.16a) in the early 1980s, which is heralded as the first definitive commercial role-playing game and a major influence on the RPG genre. Garriott is also noted

TABLE 4.4 Notable Early Home Computer Systems from 1979 to 1988

1979	Atari 400/800, Texas Instruments TI-99/4
1980	Commodore VIC-20, Tandy TRS-80 Color Computer
1981	Osborne 1, TI-99/4A, IBM PC, Sinclair ZX81/TS 1000, BBC Micro
1982	Kaypro II, Sinclair ZX Spectrum, Commodore 64
1983	Atari 1200XL/600XL/800XL, Coleco Adam, Microsoft MSX
1984	Apple Macintosh, Amstrad CPC
1985	Atari 65XE/130XE, Atari ST, Commodore 128, Commodore Amiga
1986	Compaq Portable II, IBM Convertible, Apple IIGS
1987	Atari XEGS (XE Game System), Acorn Archimedes
1988	Apple IIc Plus, NeXT

FIGURE 4.16 Screenshots from the PC version of (a) *Ultima* (1981) and (b) *Tetris* (1986).

(a) (b)

for coining the term **"Massively Multiplayer Online Role-Playing Game" (MMORPG)**, providing a fresh identity to graphical Multi-User Dungeon (MUDs) games many years later.

Another genre that made its debut on personal computers was the "falling blocks" puzzle game. The pioneer of this type of game was Moscow's **Alexey Pajitnov** with his mega hit ***Tetris*** (Figure 4.16b) developed in 1984. Published by Spectrum HoloByte for both Commodore 64 and IBM PC, Tetris was the first software title to be exported from the Soviet Union to the United States. The game involves dropping various puzzle-like shapes called "Tetriminos" to form horizontal lines, which disappear and add points to the user's score.

While *Tetris* sold well on PC and was ported to the arcades in 1988, its popularity skyrocketed when it was bundled as the **pack-in** title for Nintendo's GameBoy handheld system which released in 1989. It wasn't long before almost every major game manufacturer developed some kind of spinoff from *Tetris*, such as Sega's *Columns* (1990), Taito's *Bust-A-Move/Puzzle Bobble* (1994), and Capcom's *Super Puzzle Fighter II Turbo* (1996), among countless others.

Another pioneer of the early PC generation included Ontario's **Sid Meier**—known for his strategy and simulation games, such as *Sid Meier's Pirates!* (1987) (Figure 4.17a), *Sid Meier's Railroad Tycoon* (1990), and the turn-based ***Civilization*** series which began in 1991. Meier (with MicroProse co-founder Bill Stealey) redefined the "open-ended" genre. His games fostered features like character creation, plus a multitude of choices and opportunities for players to engage in as they essentially created their own adventures.

The first "city-building" simulation game was ***SimCity*** (Figure 4.17b) by Atlanta's **Will Wright** in 1989. Published by Maxis (which became a division of

FIGURE 4.17 Screenshots of (a) *Sid Meier's Pirates!* (1987), (b) *SimCity* (1989), and (c) *Populous* (1989).

(a) (b) (c)

EA), players are provided with tools to develop a city from an overhead perspective. The gameplay involves defining zones (such as residential, commercial, and industrial) and providing adequate power, transportation, and other resources to keep the citizens happy and within budget. *SimCity* led to many spinoffs such as *SimFarm, Sim City: The Card Game, SimCopter, Streets of SimCity, SimsVille*—but the series may be most notable for carving the way for *The Sims* games, which pioneered the strategic "life-simulation" genre.

England's **Peter Molyneux** created the "god games" genre, where the player uses supernatural powers to influence a population of simulated worshipers. Unlike in strategy games, players in god games do not have the ability to give direct commands to units of people. Gameplay instead primarily revolves around growing and utilizing one's supernatural powers, such as blessing a civilization's crops or destroying them with natural disasters (Rollings & Adams, 2006). Notable god games from Molyneux include ***Populous*** (1989) (Figure 4.17c), *Dungeon Keeper* (1997), and *Black & White* (2001).

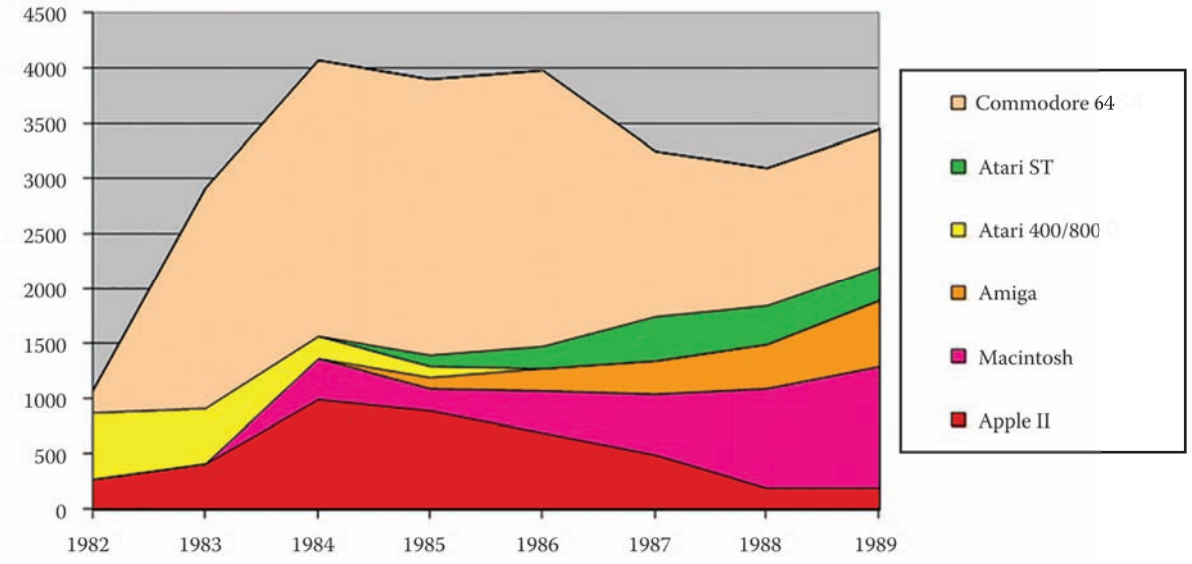
■ MARKET SUMMARY

The initial market for the Apple II consisted only of electronics hobbyists, gamers, and computer enthusiasts. Sales expanded to the business market when the spreadsheet program **VisiCalc** was released in 1979 and Apple grew exponentially over its first 5 years—doubling operations revenues approximately every 4 months. Between September 1977 and September 1980, annual Apple sales grew from $775,000 to $118 million, an average annual growth rate of 533% (Malone, 1999, p. 157).

Atari outsold the Apple II from the beginning, but Atari's machines were expensive to produce. By mid-1981, it had reportedly lost $10 million on sales of $10 million (Hogan, 1981, pp. 6–7). Then home computer prices plummeted in 1983. Caught between the video game crash and the low-priced Commodore 64, Atari and Apple were forced into a price war. Atari dropped the successor to the 400 and 800 computers (the 1200XL) just months after its release and quickly replaced it with the 600XL and 800XL which debuted at only $199 and $299, respectively, to only modest sales.

Even at their peak in 1984, Atari's 8-bit line sold less than half the number of Commodore 64 units, as illustrated in Figure 4.18. According to Commodore, the C64 sold as many as 17 million systems and "the *Guinness Book of World Records* lists the Commodore 64 as the best-selling single computer model of all time" (Griggs, 2011, para. 5). By 1986, however, the market share shifted to IBM compatible computers, which would soon dominate more than 75% of the market. Atari and Commodore computers were eventually discontinued in the 1990s, with only Apple surviving—albeit in a distant second place.

FIGURE 4.18 Early computer sales in thousands of units by Apple, Atari, and Commodore.



■ ACTIVITY: GAME DEVELOPER REPORT AND PRESENTATION

Choose a small-to-medium size game developer (avoid large companies like Nintendo, Sega, Sony, and Microsoft) and write a report and presentation on the following:

1. Company history and key employees
2. Key games the company created
3. Any breakthroughs, catastrophes, or other major happenings with the company
4. The cultural impact of the company's games (societal trends, influences, lasting appeal, spin-offs)

The report should contain four main points and three quotes which are paraphrased or cited verbally in the speech. Conclude with where the company is today and whether the trends their games created will continue to be popular in the future. The recommended total presentation length is 4–5 minutes, not to exceed 6 minutes total.

■ CHAPTER 4 QUIZ

1. This computer programmer went on to form Apple with Steve Jobs:
   a. Steve Wozniak
   b. Ray Kassar
   c. Nolan Bushnell
   d. Trip Hawkins

2. Apple's first *commercially* produced computer system for the mainstream home PC market:
   a. Apple I
   b. Apple II
   c. Macintosh Core
   d. Core Macintosh

3. Sierra Entertainment Inc. (Formerly Sierra On-Line and On-Line Systems) was the company in which Ken and Roberta Williams pioneered the _____ genre of games.
   a. Text adventure game
   b. Spoken adventure game
   c. Graphical adventure game
   d. None of the above

4. Coined by Roy Trubshaw in 1978, these text-based adventures called "MUDs" stood for:
   a. Massively Uber Dungeoncrawlers
   b. Mind-User Development games
   c. Micro Universe Dungeons
   d. Multi-User Dungeons

5. Founded Electronic Arts, with a focus on crediting programmers on its album-like box art; also paved the way for athlete and celebrity endorsed games:
   a. Steve Wozniak
   b. Rod Holt
   c. Trip Hawkins
   d. Jack Tramiel

6. This computer had a membrane keyboard to protect against spills from the children who were its target market:
   a. Apple IIe
   b. Atari 400
   c. Atari 800
   d. Atari 1200XL

7. This 1979 exclusive was one of the Atari 8-bit computer's earliest titles and remained one of the reasons many gamers purchased an Atari computer for many years:
   a. *Star Raiders*
   b. *Asteroids*
   c. *Rescue on Fractalus!*
   d. *King's Quest*

8. Founded Commodore International in 1954 as a typewriter assembly plant and went on to produce computers "for the masses, not the classes":
   a. Steve Wozniak
   b. Rod Holt
   c. Trip Hawkins
   d. Jack Tramiel

9. The reason(s) for the success of the Commodore 64:
   a. Low price for a fully-functional PC with 64 KB of RAM
   b. Commodore manufactured many of its parts in-house
   c. Marketing and selling the C64 in retail stores like Sears
   d. All of the above

10. This computer was known for its improved processing chip that allowed for "multi-color sprites" which made it easier to create fast-moving, flicker-free game graphics:
    a. Apple II
    b. Atari 400/800
    c. Commodore 64
    d. VIC-20

11. This computer manufacturer released many versions of its 8-bit computer lineup, including the XL series, XE series, and XE Game System (XEGS):
    a. Apple
    b. Atari
    c. Commodore
    d. IBM

12. All three original 8-bit computers by Apple, Atari, and Commodore contained a CPU manufactured by:
    a. Microsoft
    b. MOS Technology
    c. Minolta
    d. Magnavox

13. Known as alter ego "Lord British" and "General British" in his games, this programmer created the pioneering *Ultima* RPG series and coined the term MMORPG:
    a. Richard Garriott
    b. Sid Meier
    c. Will Wright
    d. Alexey Pazhitnov

14. Responsible for developing the "falling blocks" puzzle game *Tetris*:
    a. Richard Garriott
    b. Sid Meier
    c. Will Wright
    d. Alexey Pazhitnov

15. Created the first "city-building" simulation games, which led to the strategic "life-simulation" genre with games like *The Sims*:
    a. Richard Garriott
    b. Sid Meier
    c. Will Wright
    d. Alexey Pazhitnov

16. This computer won the early PC market by a wide margin and is regarded as the best-selling single computer model of all time:
    a. Apple II
    b. Atari 400/800
    c. Commodore 64
    d. VIC-20

True or False

17. The Apple II was known for its state of the art SID 6581 sound processor.

18. Will Crowther's *Colossal Cave Adventure* (1976) for the PDP-10 mainframe computer pioneered the text adventure genre, also known as "interactive fiction."

19. The abbreviation RPG stands for "Role-Playing Game."

20. Most of the games for Commodore 64 were manufactured on floppy disk.

■ FIGURES

FIGURE 4.1 Apple Computer advertisement from Interface Age magazine, Oct. 1976. (Scanned from page 11 of the October 1976 *Interface Age* magazine by Michael Holley. Author: Apple Computer Company, Palo Alto, CA. Permission: This advertisement did not have a copyright notice and is in the public domain. From the US Copyright Office Circular 3. Page 3, Contributions to Collective Works. Retrieved from https://upload.wikimedia.org/wikipedia/commons/4/48/Apple_1_Advertisement_Oct_1976.jpg)

FIGURE 4.2 The Apple II (1977) with two Disk II floppy disk drives and a 1980s-era Apple Monitor II (left) and the Apple II Plus (1979) without peripherals. (Courtesy of Rama, CC BY-SA 2.0 fr. Available at https://commons.wikimedia.org/w/index.php?curid=29591429 and "Apple II Plus" By Bilby - Own work, CC BY 3.0. Retrieved from https://en.wikipedia.org/wiki/Apple_II_Plus#/media/File:Apple_II_Plus.jpg)

FIGURE 4.3 Magazine advertisement for the Apple II computer. ("Apple II 1979 Advertisement: How to Buy" from "The 7 Principles Of Apple" by Mike Cane. December 2, 2009. Retrieved from https://ebooktest.wordpress.com/2009/12/02/the-7-principles-of-apple/)

FIGURE 4.4 Screenshots of early Apple II titles (from left to right): *The Oregon Trail* (MECC/Brøderbund, 1978), *Lemonade Stand* (MECC/Apple, 1979), and *Zork I: The Great Underground Empire* (Infocom, 1980). (*The Oregon Trail* courtesy of MECC/Brøderbund, 1978; *Lemonade Stand* courtesy of MECC/Apple, 1979; and *Zork I: The Great Underground Empire* courtesy of Infocom, 1980.)

FIGURE 4.5 Evolution of the adventure game: Screenshots (from left to right): *Colossal Cave Adventure* (William Crowther and Don Woods, 1976), *Mystery House* (On-Line Systems, 1980), and *King's Quest* (Sierra On-Line/Sierra Entertainment, 1984). (*Colossal Cave Adventure* courtesy of William Crowther and Don Woods, 1976; *Mystery House* courtesy of On-Line Systems, 1980; and *King's Quest* courtesy of Sierra On-Line/Sierra Entertainment, 1984.)

FIGURE 4.6 Box art to five defining Apple II titles (left to right): *The Bard's Tale* (Interplay Productions/Electronic Arts, 1985), *Pinball Construction Set* (BudgeCo/Electronic Arts, 1983), *The Oregon Trail* (MECC/Brøderbund, 1978), *Karateka* (Jordan Mechner/Brøderbund, 1984), and *Ultima I: The First Age of Darkness* (Richard Garriott/Origin Systems, 1981). (*The Bard's Tale* courtesy of Interplay Productions/Electronic Arts, 1985; *Pinball Construction Set* courtesy of BudgeCo/Electronic Arts, 1983; *The Oregon Trail* courtesy of MECC/Brøderbund, 1978; Karateka courtesy of Jordan Mechner/Brøderbund, 1984; and *Ultima I: The First Age of Darkness* courtesy of Richard Garriott/Origin Systems, 1981.)

FIGURE 4.7 Atari 400 and 800 computer systems. (Courtesy of Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=17758254 Retrieved from https://en.wikipedia.org/wiki/Atari_8-bit_family#/media/File:Atari-400-Comp.jpg and "The Atari 800, an 8-bit computer released by Atari in 1979. Based off the MOS 6502 microprocessor and custom video and sound processors, the Atari 800 was the first in a line of popular home computers." By Evan-Amos - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=53205709. Retrieved from https://en.wikipedia.org/wiki/Atari_8-bit_family#/media/File:Atari-800-Computer-FL.jpg. "Atari 400, 1979. Featuring a membrane keyboard and single-width cartridge slot cover.")

FIGURE 4.8 Screenshots of Atari 8-bit family titles (from left to right): *Rainbow Walker* (Synapse Software, 1983), *Bounty Bob Strikes Back* (Big Five Software, 1984), and *Rescue on Fractalus!* (Lucasfilm Games/Activision, Atari, Epyx, 1984). (*Rainbow Walker* courtesy of Synapse Software, 1983; *Bounty Bob Strikes Back* courtesy of Big Five Software, 1984; and *Rescue on Fractalus!* courtesy of Lucasfilm Games/Activision, Atari, Epyx, 1984.)

FIGURE 4.9 Box art to five defining Atari 8-bit family games (left to right): *Star Raiders* (Atari, Inc., 1979), *M.U.L.E.* (Ozark Softscape/Electronic Arts, 1983), *Bounty Bob Strikes Back* (Big Five Software, 1984), *Rescue on Fractalus!* (Lucasfilm Games/Activision, Atari, Epyx, 1984), and *Boulder Dash* (First Star Software, 1984). (*Star Raiders* courtesy of Atari, Inc., 1979; *M.U.L.E.* courtesy of Ozark Softscape/Electronic Arts, 1983; *Bounty Bob Strikes Back* courtesy of Big Five Software, 1984; *Rescue on Fractalus!* courtesy of Lucasfilm Games/Activision, Atari, Epyx, 1984; and *Boulder Dash* courtesy of First Star Software, 1984.)

FIGURE 4.10 Magazine advertisement for the Atari 800 computer in 1981. (Atari 800 ad posted in "The Timeless Computer: Remembering the Atari 800" by John Kenneth Muir on December 7, 2015. Available at http://flashbak.com/timeless-computer-remembering-atari-800-47864/. Retrieved from: http://flashbak.com/wp-content/uploads/2015/12/flashbak800b.jpg.)

FIGURE 4.11 Evolution of the Atari 8-bit computers (from top) 1200XL, 600XL, 800XL, 130EX, and XE Game System. ("Atari 1200XL" by Daniel Schwen, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=16255854 and "Atari 600XL". "This machine featured a slightly shallower case than the 800XL." by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=17835117. "An Atari 800XL," by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18553927. "Atari 130XE," by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid

=18548917. "Atari XE Game System," by Bilby - own work, CC BY 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=10955083)

FIGURE 4.12 Commodore 64 home computer system. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17414886. "Commodore 64.")

FIGURE 4.13 Magazine advertisement for the Commodore 64 computer in 1982. (From "Commodore Computers" posted on MagazineAdvertisements.com. Retrieved from http://www.magazine-advertisements.com/commodore-computers.html)

FIGURE 4.14 Screenshots of early Commodore 64 titles (from left to right): *Choplifter* (Dan Gorlin/Brøderbund, 1982), *Spy Hunter* (Bally Midway, 1983), and *Impossible Mission* (Epyx, 1984). (*Choplifter* courtesy of Dan Gorlin/Brøderbund, 1982; *Spy Hunter* courtesy of Bally Midway, 1983; and *Impossible Mission* courtesy of Epyx, 1984.)

FIGURE 4.15 Box art to five defining Commodore 64 titles (left to right): *IK+* (System 3/Epyx, 1987), *Zack McKracken and the Alien Mindbenders* (Lucasfilm Games, 1988), *Impossible Mission* (Epyx, 1984), *Turrican II* (Rainbow Arts, 1991), and *Paradroid* (Graftgold/Hewson Consultants, Jester Interactive Publishing, 1985). (*K+* courtesy of System 3/Epyx, 1987; *Zack McKracken and the Alien Mindbenders* courtesy of Lucasfilm Games, 1988; *Impossible Mission* courtesy of Epyx, 1984; *Turrican II* courtesy of Rainbow Arts, 1991; and *Paradroid* courtesy of Graftgold/Hewson Consultants, Jester Interactive Publishing, 1985.)

FIGURE 4.16 Screenshots from the PC version of *Ultima I: The First Age of Darkness* (Richard Garriott/Origin Systems, 1981) and *Tetris* (List, 1986). (*Ultima I: The First Age of Darkness* courtesy of Richard Garriott/Origin Systems, 1981; *Tetris* courtesy of List, 1986.)

FIGURE 4.17 Screenshots of *Sid Meier's Pirates!* (MicroProse, 1987), *SimCity* (Maxis, 1989), and *Populous* (Bullfrog/Electronic Arts, 1989). (*Sid Meier's Pirates!* courtesy of MicroProse, 1987; *SimCity* courtesy of Maxis, 1989; and *Populous* courtesy of Bullfrog/Electronic Arts, 1989.)

FIGURE 4.18 Early computer sales figures in thousands of units. (Adapted from data by Reimer, Jeremy. "Personal Computer Market Share: 1975-2004" 2012. Retrieved from http://www.jeremyreimer.com/m-item.lsp?i=137)

Pro File: Steve Wozniak. Photo credit: Al Luckow. Homepage of Steve Wozniak, Copyrighted free use, https://commons.wikimedia.org/w/index.php?curid=182507.

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The 8-bit Era

OBJECTIVES

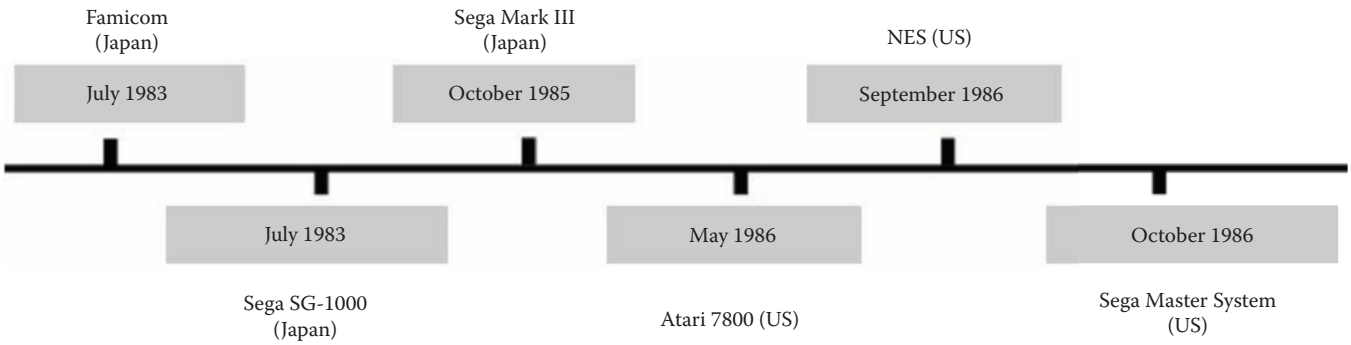
After reading this chapter, you should be able to:

- Summarize a brief overview of the history of Nintendo and Sega.
- Understand the challenges Nintendo overcame to bring the NES to the United States.
- Explain how names like Famicom, Sega, and 7800 were formed.
- Describe how Japanese consoles were redesigned for the American audience.
- Be familiar with the technological differences among third-generation consoles.
- List some of the key video game titles for each console.
- Recognize the impact Shigeru Miyamoto and *Super Mario Bros.* had on gaming.
- Illustrate how Nintendo dominated the third-generation market.
- List several innovations Nintendo brought to gaming during this time period.
- Identify the graphics and capabilities of third-generation video game consoles.
- Summarize third-generation market sales, breakthroughs, and trends.

■ KEY TERMS AND PEOPLE

10NES
Activision
Advanced Video System
Minoru Arakawa
Atari Games (Division)
Arcade ports
Atari 2600 Jr.
Atari 7800 Proline Controller
Atari 7800 ProSystem
Atari Corporation
Backwards compatibility
Capcom
Central Processing Unit
Coleco
Color Game-TV series
Commodore
Consumer Electronics Show
Digital signature
D-pad controller
Easter Eggs
Famicom
Game & Watch
General Consumer Corporation
Japanese role-playing game
Ray Kassar
Konami
Licensing policy (NES)
Howard Lincoln
Master System
Mastertronic
Multicart
NES Zapper
Nintendo Co., Ltd.
Nintendo Entertainment System
POKEY
Random access memory
Robot Operating Buddy (R.O.B.)
Rosen Enterprises
SALLY
Screen resolution
Seal of Quality (NES)
Sega Card
Sega Enterprises
Sega Light Phaser
Sega Mark III
Sega SG-1000
SegaScope 3D Glasses
Shigeru Miyamoto
Side-scrolling platformer
Super Mario Bros.
Yu Suzuki
Taito
TechToy
Tecmo
Third-party developer
TIA
Tonka
Jack Tramiel
Video cassette recorder
Warner Communications
Worlds of Wonder
Hiroshi Yamauchi

■ CONSOLE TIMELINE



■ THE ARCADE SCENE

With the end of the Golden Age and the Video Game Crash of 1983 in North America, the arcade market experienced a steady decline during the mid-1980s. The console market would be revived by Nintendo, but the games that brought players back to their TVs during this time were quite different from those in the arcades. Many console games during the third generation were more intricate than their arcade counterparts, containing more elaborate stories, secrets to be discovered, and a greater time commitment. Console action/adventure games now often took several hours to complete. Role-playing console games could last for 10 hours or longer.

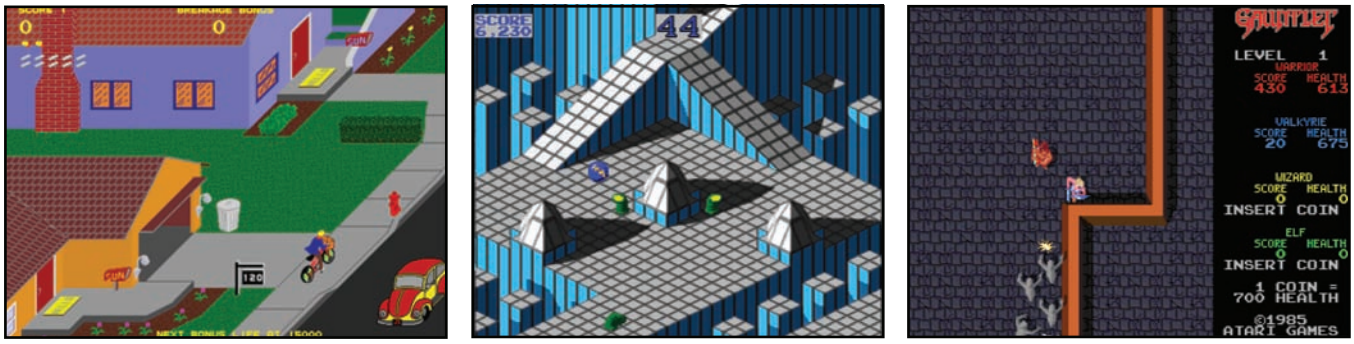
Nintendo all but pulled the plug on the arcade market to focus on the Nintendo Entertainment System. **Capcom** entered the arcade market around this time and large companies such as **Atari** (Figure 5.1), **Sega**, **Taito**, and **Konami** continued to release enough titles to keep the arcades afloat. Each of these companies was also developing console titles, which helped them remain profitable. Home ports of arcade hits were still common, but many console games that shared the same title as arcade games were alike in name only. Games like Capcom's *Bionic Commando* and **Tecmo's** *Ninja Gaiden* were completely different games on home consoles and were not considered ports of the arcade originals.

One game that helped attract gamers back to the arcades was Sega's *Hang-On* in 1985. Developed by **Yu Suzuki** and his Sega AM2 team, the game utilized pseudo-3D, "Super Scaler" sprite-scaling and a motion-controlled hydraulic motorbike cabinet where players controlled what looked and felt like real motorcycle handles. The game even mirrored the angle of the seat, where players could lean left and right to control the motorcycle on-screen. This led to other popular hydraulic titles by Sega such as *Space Harrier* (1985), *OutRun* (1986), and *After Burner* (1987).

■ THE THIRD GENERATION: NINTENDO FAMICOM

The third generation of video games (also called the "8-bit era"), began in Japan with **Sega** and **Nintendo**. **Nintendo Koppai** was founded in 1889 by Fusajiro Yamauchi. The company's original operation was the manufacturing of Japanese playing cards. It wasn't until the early 1970s that the newly branded **Nintendo Co., Ltd.** began developing electronic games. Its first major video game success was the *Pong*-like **Color TV-Game**

FIGURE 5.1 Atari still delivered defining arcade games after the Video Game Crash of 1983, including (a) *Paperboy* (1984), (b) *Marble Madness* (1984), and (c) *Gauntlet* (1985).



(a) (b) (c)

FIGURE 5.2 Nintendo Famicom game system and its unique d-pad controllers.

series in the late 1970s, followed by its **Game & Watch** LCD handheld games in 1980.

The company reached international success with the arcade hit *Donkey Kong*, before releasing its debut third-generation console, the **Nintendo Famicom** (Figure 5.2). The title Famicom was derived from its formal name "Family Computer." The system was introduced in Japan on July 15, 1983 for 14,800 yen (around $120 U.S. dollars). It had three launch titles, including arcade ports of *Donkey Kong*, *Donkey Kong Jr.*, and *Popeye* (Figure 5.3).

DID YOU KNOW?

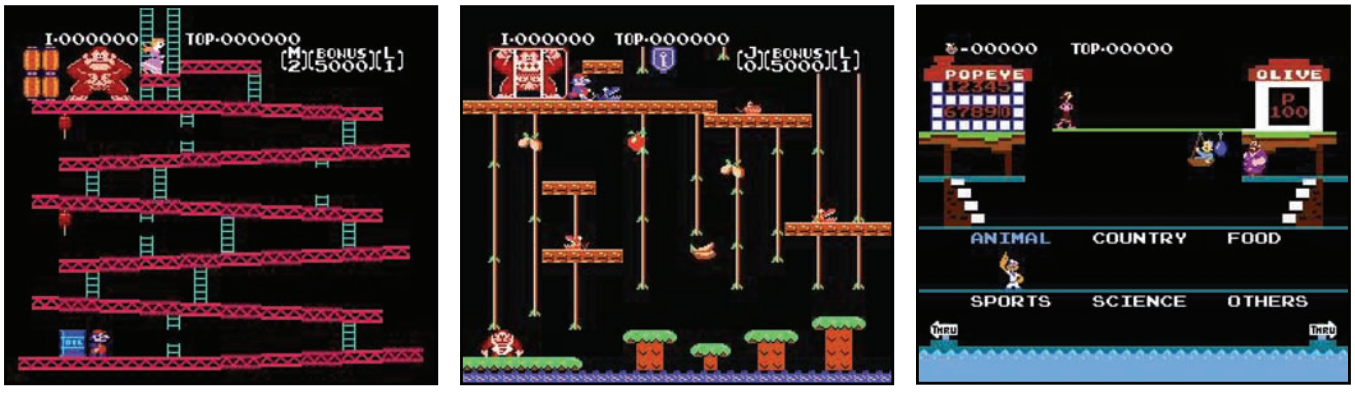
The first batch of Famicoms had a bad chip set, causing a massive recall and reissue with all new motherboards. Once they got over this hurdle, Nintendo went on to sell "more than 500,000 Famicoms within two months" (Kent, 2001, p. 279).

■ COMING TO AMERICA

Despite the recent video game crash in North America, Nintendo president **Hiroshi Yamauchi** believed the Famicom could still succeed in the United States. Nintendo of America President **Minoru Arakawa** and Vice President **Howard Lincoln** offered **Atari** the chance to distribute the system in the United States (or to use the Famicom board inside an Atari-built console). Many meetings with **Ray Kassar** and Atari ensued, and it appeared the two companies had a deal. Then at the 1983 **Consumer Electronics Show (CES)** in Chicago, Atari learned that Nintendo had licensed *Donkey Kong* to Atari's competitor **Coleco** for play on the Coleco Adam Computer. Kassar claimed this "breached the licensing agreement Atari had made with Nintendo" (Kent, 2001, p. 283) and the deal with Atari was never completed.

Kassar was forced to resign from Atari that July from allegations of insider trading after he sold 5,000 shares of

FIGURE 5.3 Screenshots of Famicom launch titles: (a) *Donkey Kong*, (b) *Donkey Kong Jr.*, and (c) *Popeye.*



(a) (b) (c)

FIGURE 5.4 The first redesign of Famicom, called the Nintendo Advanced Video System.

Warner stock just minutes before the company's fourth quarter loss report was released. Besides Atari's financial crisis and the declining market in the United States, another possible culprit for the fallout was the fact that unbeknownst to Nintendo, Atari already had another console in development, the **Atari 7800**.

The Famicom became the best-selling game console in Japan by the end of 1984 with over 3 million units sold. Yamauchi was ready to give America another shot and sent Arakawa to unveil the console at the Las Vegas Consumer Electronics Show in January 1985. The console was renamed the **Advanced Video System (AVS)** and displayed at a small booth with around 25 games. It was bundled with a keyboard, cassette data recorder, and BASIC interpreter software cartridge. The redesigned system (displayed in Figure 5.4) looked more like a home computer than a video game console.

The CES presentations showed that the U.S. market was quite skeptical of re-entering the video game arena. While the AVS showing was not a huge success, Nintendo gathered enough data from focus groups to go back to the drawing board.

■ NINTENDO ENTERTAINMENT SYSTEM

In attempt to appeal to U.S. consumers, Nintendo redesigned the look of the system a second time and renamed the console the **Nintendo Entertainment System (NES)** (Figure 5.5). The home computer approach was completely abandoned and the top loading cartridge slot was changed to a front-loading slot with a dust cover door, more closely resembling a **Video Cassette Recorder (VCR)** than any game system developed up to that time.

FIGURE 5.5 Nintendo Entertainment System and its restyled d-pad controller.

FIGURE 5.6 Pages from the 1986 CES NES Brochure showing R.O.B., the Zapper, and newly designed Nintendo Entertainment System.

In addition to avoiding the term "video games" in the eyes of retailers, Nintendo was careful to name and market the console as an "entertainment system." To compliment this marketing campaign, the system included the addition of an optional **NES Zapper** light gun accessory and **Robot Operating Buddy (R.O.B.)** (shown in Figure 5.6) developed by **Gumpei Yokoi**. The Zapper only supported a few initial games such as *Wild Gunman, Duck Hunt*, and *Hogan's Alley*, but would see enough releases on the system to warrant its purchase for shooting fans. R.O.B. on the other hand, only worked with two games at launch (*Gyromite* and *Stack-Up*). While the robot gave the system a unique sense of identity, R.O.B. was unpopular in both the United States as well as Japan, and never received a third title before being discontinued. Small software support aside, these peripherals made the NES appear quite advanced during its time of release in the mid-1980s.

Beyond these peripheral devices, it was the NES controller that truly revolutionized the industry. Prior to the launch of the NES, most video game system controllers utilized a joystick to control the on-screen action. Nintendo changed all of that with its + shaped **directional pad** or **"d-pad."** The d-pad was developed by Gumpei Yokoi in the late 1970s for Nintendo's **Game & Watch** handhelds. Its comfort and precision helped the d-pad become the standard method of controlling video games until Nintendo's touch sensitive **control stick** for the Nintendo 64 more than a decade later. Even today, most video game controllers still contain a d-pad in one form or another.

DID YOU KNOW?

In addition to designing the Game & Watch handheld, d-pad, and R.O.B., Gumpei Yokoi helped Shigeru Miyamoto on *Donkey Kong* and was a key developer on games like *Kid Icarus* and *Metroid* before designing the hugely successful **Game Boy** in 1989.

With the redesigned **Nintendo Entertainment System** ready to go, Nintendo prepared to test the U.S. market. Rather than follow Nintendo of America's test

market plans to start in small markets, Yamauchi chose to go right to New York City for the 1985 holiday season. To help convince retailers to carry their product, Arakawa offered a money back guarantee for any unsold merchandise and had Nintendo staff set up all the in-store displays (Kent, 2001, p. 297). Among the 500 retailers who took a gamble with the system, Nintendo was able to secure deals with FAO Schwartz and Toys "R" Us.

Nintendo sold at least **50,000 units** in New York in 1985—about half the number of consoles it shipped to the United States. Nintendo's test launch was a reasonable success considering *Super Mario Bros.* had not yet been released. That game would not reach the United States until the national launch in September 1986, joining a whopping 17 other available titles (Table 5.1). That year Nintendo also secured former toy giant **Worlds of Wonder** (Teddy Ruxpin, Lazer Tag) as a distributor.

TABLE 5.1 Nintendo Entertainment System U.S. Launch Titles

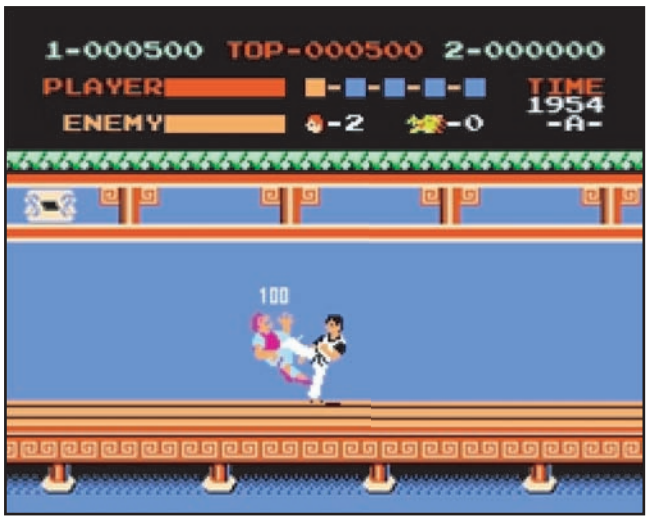
- 10-Yard Fight
- Baseball
- Clu Clu Land
- Donkey Kong Jr. Math
- Duck Hunt
- Excitebike
- Golf
- Gyromite
- Hogan's Alley
- Ice Climber
- Kung Fu (Figure 5.7a)
- Mach Rider
- Pinball
- Stack-Up
- Super Mario Bros. (Figure 5.7b)
- Tennis
- Wild Gunman
- Wrecking Crew

Nintendo remained mindful of the recent video game crash in the United States and set out to regain the confidence of both consumers and retailers. Game cartridges were called "game paks" instead of "video games." To avoid the problems Atari had with too many poor third-party titles flooding the market, Nintendo instilled a strict **licensing policy**. Under the policy, third-party companies had to order at least 10,000 cartridges up front, to be manufactured exclusively by Nintendo (Sheff, 1993, pp. 215–215). Each publisher was only allowed to produce five games per year for Nintendo, and these titles were not permitted to appear on other game systems.

To avoid piracy issues they encountered with the Famicom in Asia, Nintendo installed a special lock-out chip in every NES console that had to be paired with a counterpart chip installed in every officially licensed cartridge. Known as the **10NES**, if the chip could not detect a cartridge's counterpart chip, the game would fail to load (Sheff, 1993, p. 247). In addition to these measures, Nintendo created a **'Seal of Quality'** that appeared on the packaging of aptly licensed games and accessories.

By 1988, Nintendo cartridges were in higher demand than all computer software combined (Computer Gaming World, 1988, p. 50). The marketing phrase "Now You're Playing with Power" became a popular part of their advertising; however, it was *Nintendo* who was in power now. The NES had singlehandedly revived the once presumed dead video game market in the United States and became the world's leading game console.

FIGURE 5.7 Screenshots from NES launch titles (a) *Kung Fu* and (b) *Super Mario Bros.*



(a)

(b)

TABLE 5.2 Famicom/Nintendo Entertainment System Tech Specs	
Manufacturer:	Nintendo
Launch Price:	$199.99
Release Date:	7/15/83 (JP), 10/18/85 (US), 9/01/86 (EU/US national)
Format:	Cartridge
CPU:	8-bit Ricoh processor (1.79 MHz)
Memory:	2 KB RAM, 2 KB VRAM
Resolution:	256 × 240 pixels
Colors:	24 on-screen from palette of 52
Sound:	5 channel mono

■ CONSOLE COMPARISON: NES VERSUS ATARI 2600 (VCS)

Compared to the previous leading game console, the NES launched for $199.99 shortly after the video game crash in the United States, where an Atari VCS/2600 could be picked up for less than $50. As for the CPU, the NES's **1.79 MHz 8-bit Ricoh 6502 processor** (Table 5.2) did not look much better than Atari's 1.19 MHz 8-bit 6507 processor on paper, but technology had come a long way since the VCS was built and Nintendo was able to squeeze a lot more power out of its chip. The NES also had over 15 times more RAM at **2 KB RAM** versus Atari's 128 bytes RAM, as well as an addition **2 KB VRAM** dedicated to graphics.

The NES displayed a screen resolution of 256 × 240 pixels (screen dots), compared to the 2600's resolution of 160 × 192 pixels. It could also display 24 on-screen colors from a palette of 52, where the 2600 only displayed 4 colors per scan line. Finally, the NES was able to output **5 channels of mono sound**, compared to Atari's 2 channel mono sound. The difference in sound was as drastic as the improvement in graphics. While the Atari mostly outputted beeps and fuzzy noises (save for a few well-programmed, single-track theme songs), the NES could produce more intricately arranged music with a separate channel devoted entirely to percussion.

HEAD-TO-HEAD

To compare the graphics and sound between the NES and 2600, play games that were released on both consoles (or watch video clips of them). Some games to compare include *Bump 'n' Jump, Donkey Kong, Ghostbusters, Mario Bros.*, and *Ms. Pac-Man*.

■ KEY NES TITLES

One of the major reasons for the early success of the Nintendo Entertainment System in America has to be attributed to *Super Mario Bros.*, which became the pack-in title with every NES console when the system was launched nationally. *Super Mario Bros.* was the brain-child of *Donkey Kong* designer **Shigeru Miyamoto**. Where most of the games that preceded it took place on a single (often black background) screen, *SMB* transported players to a vibrant, scrolling world filled with secrets (i.e., **Easter eggs**) that gave gamers a sense of exploration and discovery. It really distinguished the NES from the previous generation of consoles and showed what the

FIGURE 5.8 Box art to five prestigious NES titles baring the Nintendo Seal of Quality: (a) *Super Mario Bros.*, (b) *Contra*, (c) *The Legend of Zelda*, (d) *Mega Man 2*, and (e) *Metroid*.

(a) (b) (c) (d) (e)

PRO FILE

SHIGERU MIYAMOTO

KEY FACT:

The Super Mario series is collectively the best selling video game franchise of all time with approx. 300 million copies sold as of 2016.

PRO FILE

HISTORY:

- Born: November 16, 1952
Sonobe, Kyoto, Japan

EDUCATION/CAREER:

- Degree in industrial design from Kanazawa Municipal College of Industrial Arts
- Hired as Nintendo's first artist in 1977

CAREER HIGHLIGHTS:

- Donkey Kong (series) Creator
- Super Mario Bros. (series) Producer/Director/Designer
- The Legend of Zelda (series) Producer/Director
- Star Fox (series) Creator
- Super Mario Kart (series) Producer
- Pikmin (series) Creator/Producer
- Metroid Prime (2002) Producer

RECOGNITION:

- First person inducted into the Academy of Interctive Arts and Sciences' Hall of Fame in 1998.
- GDCA Lifetime Achievement Award in 2007

system was capable of. While there were several side-scrolling shooter games that came out before it, *SMB* was one of the first **side-scrolling "platformer"** games and pioneered this genre of gameplay.

The NES gave birth to numerous key titles, many of which are still seeing sequels and reinventions today. The three *Super Mario Bros.* games were the NES's top selling games of all time (not counting *Duck Hunt* which was bundled with *Super Mario Bros.* and included with the Action and Deluxe sets). Other notable series that began on the NES included Miyamoto's *The Legend of Zelda* and *Metroid* (shown in Figure 5.8) from Gunpei Yokoi. Each of these games placed an emphasis on non-linear exploration and powering up one's character—setting new standards for action adventure games. Third-party titles such as Capcom's *Mega Man*, Konami's *Castlevania*, Tecmo's *Ninja Gaiden*, and *Dragon Quest (Dragon Warrior* in the United States) by Enix all saw at least three titles on the NES. The system was also home to the original console versions of *Final Fantasy, Metal Gear*, and many others. Over 700 titles were officially licensed for the NES (with 1000+ games in Japan).

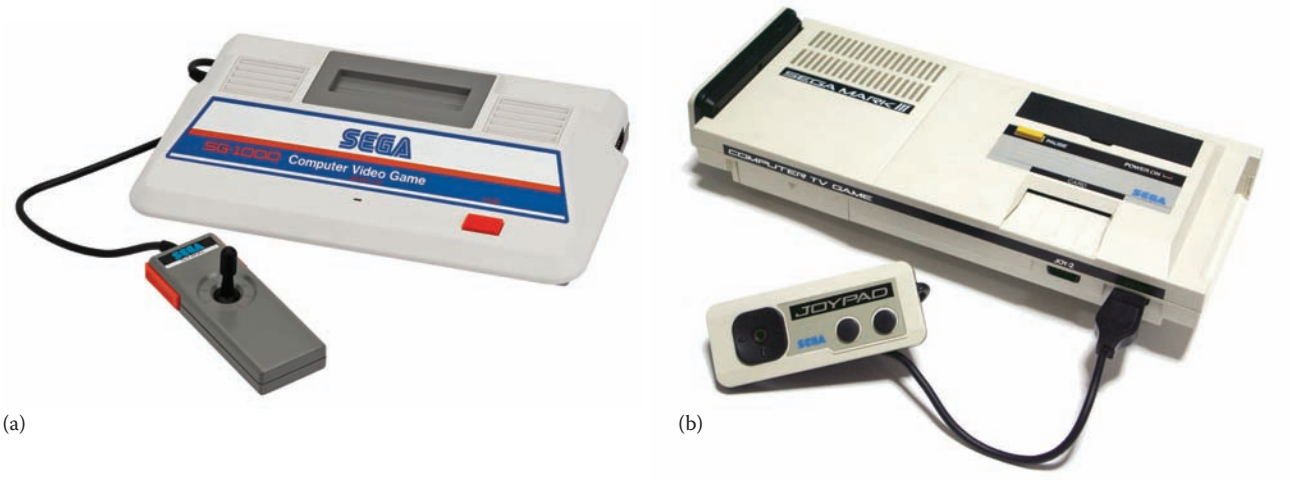
■ SEGA MARK III

Sega Games Co., Ltd. began in 1940 as an American company called **Standard Games**. It was formed by businessmen Martin Bromley, Irving Bromberg, and James Humpert in Honolulu, Hawaii to manufacture coin-operated games such as slot machines for military bases. Following World War II, the company changed its name to **Service Games** and moved to Tokyo, Japan when the U.S. government began outlawing slot machines. The company merged with competitor **Rosen Enterprises** and using the first two letters in "**Service**" and **"Games"** became **Sega Enterprises** in 1965.

With its success in the arcade business, Sega debuted on the Japanese home console market the same day as the Nintendo Famicom, introducing the **Sega SG-1000** (Figure 5.9a) on July 15, 1983. The machine was not a huge success, but served as a pivotal stepping stone to Sega's second console, the **Sega Mark III** (Figure 5.7b). The Mark III was launched in Japan on October 20, 1985 for 15,000 yen (around $120 U.S. dollars). It was basically an improved version of the SG-1000 that was specifically designed to be more powerful than the Nintendo Famicom (Parkin, 2014). The Mark III could play both cartridges and **Sega Cards** (credit card-shaped games which could be manufactured and sold for less).

Although technically superior to the Famicom, the Mark III struggled due to Nintendo's licensing policy with third-party developers that did not allow developers to port their Famicom games to other consoles. To compensate for the lack of third-party support, Sega had to obtain rights for many titles and produce the games themselves. As difficult as it was to compete with Nintendo in Japan, Sega believed they could compete in North America and other countries and began planning a U.S. release for 1986. Like Nintendo's Famicom, Sega would redesign the Mark III to appeal to Western gamers.

FIGURE 5.9 Sega's first console, the SG-1000 (a) and the Sega Mark III (b).



(a) (b)

FIGURE 5.10 Sega Master System "Power Base" and d-pad controller with joystick inserted.

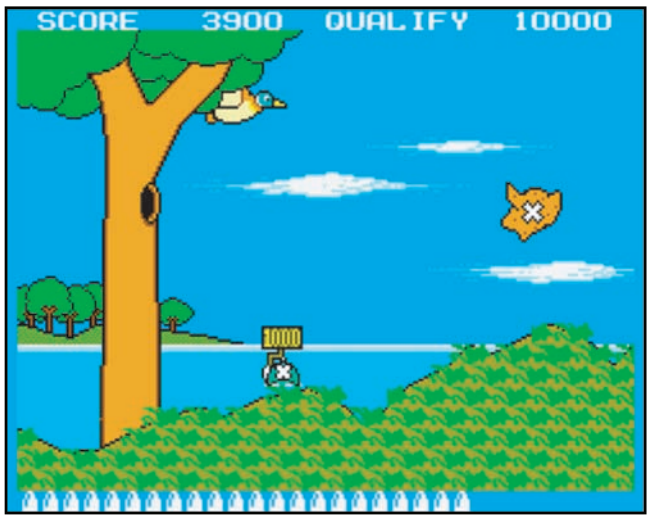
■ SEGA MASTER SYSTEM

The Mark III was redesigned and renamed the **Sega Master System** (Figures 5.10). It first appeared in North America at the June CES, but did not officially launch in the United States until October 1986, about a month after the NES national launch. The Master System released with only two games, *Hang-On* and the "Light Phaser" gun game *Safari Hunt* (Figure 5.11), which were included with the console as a **multicart** (multiple games on one cartridge). The control pad was similar to Nintendo's, with an optional small joystick that could be twisted into the center of the directional pad. In October 1987 Sega released its **"SegaScope 3-D glasses"** for a handful of 3-D games. Around this time, Nintendo bundled its "Action Set" with a more popular multicart featuring *Super Mario Bros.* and *Duck Hunt.*

Similar to the situation in Japan, the Master System and its meager game library was not nearly as successful as the Nintendo Entertainment System. And because of Nintendo's strict licensing policy, Sega was only able to obtain **Activision** and **Parker Brothers** as consistent third-party developers in the United States. With the market looking bleak in North America, Sega proceeded to distribute the Master System in Europe under **Mastertronic** in 1987 and in Brazil under **Tectoy** in 1989. The system sold well in these regions and maintained a reasonable market share in both Europe and Brazil—even after the release of the more advanced systems in the following generation (McFerran, 2014).

FIGURE 5.11 Screenshots from Sega's two U.S. launch titles (a) *Hang-On* (Sega, 1985) and (b) *Safari Hunt (Sega, 1986).*

(a)



(b)

FIGURE 5.12 Magazine advertisement for the Sega Master System in 1990.

TABLE 5.3 Mark III/Sega Master System: Tech Specs	
Manufacturer:	Sega (Service Games)
Launch Price:	$199.99
Release Date:	10/20/85 (JP), June–Sep. 1986 (US), 1987 (EU), 1989 (BR)
Format:	Cartridge (and a few titles on Sega Card)
CPU:	8-bit Zilog Z80 processor (3.57 MHz)
Memory:	8 KB main RAM, 16 KB VRAM
Resolution:	256 × 192 and 256 × 224 pixels
Colors:	32 colors from a palette of 64
Sound:	4 channel mono

■ CONSOLE COMPARISON: MASTER SYSTEM VERSUS NES

Most of the Sega Master System's specs (Table 5.3) topped the NES on paper. Its **3.57 MHz Zilog Z80** looked twice as fast as Nintendo's 1.79 MHz Ricoh processor, but it was different technology. While it *was* faster, it was certainly not *twice* as fast. For memory, the SMS contained four times the RAM with **8 KB of RAM** compared to Nintendo's 2 KB. Its **16 KB of video RAM** was eight times larger than the NES's 2 KB of video RAM. Unlike the NES, however, the SMS could not flip sprite tiles. For instance, a character facing left and right had to be drawn twice on Sega, which used up video RAM. With **32 colors** from a **palette of 64**, Sega's machine could also display 25% more on-screen color compared to Nintendo's 24 colors from a palette of 52. Nintendo's console had slightly higher resolution and an extra sound channel, but overall Sega's specs were superior.

Numbers aside—as it was seen in this and other generations, bigger numbers do not always result in bigger sales figures. Sega's games often looked better than NES titles, but overall, the NES library contained more innovative games that were arguably more fun to play. One of Sega's popular slogans for the Master System was "The Challenge Will Always Be There." In retrospect, this slogan was fitting for the company, with Nintendo's market command being the challenge that would always be there for Sega.

HEAD-TO-HEAD

To compare the graphics and sound between the NES and SMS, check out (or watch video clips of) *Double Dragon, Gauntlet, Paperboy, Rampage*, and *Shinobi*.

■ KEY SEGA MASTER SYSTEM TITLES

Sega may not have won the 8-bit console war with Nintendo, but the Master System did produce a number of important, often exclusive titles for the video game history. The role-playing game *Phantasy Star* was one of the first of its kind and one of the pioneers of the

FIGURE 5.13 Box art to five standout SMS titles including: (a) *Phantasy Star,* (b) *Shinobi,* (c) *Wonder Boy in Monster World,* (d) *Alex Kidd in Miracle World*, and (e) *Zillion.*

(a) (b) (c) (d) (e)

Japanese role-playing game (JRPG). Alex Kidd became the de facto mascot of sorts for the Master System, but was nowhere near as popular as Nintendo's Mario. The *Alex Kidd* series spawned many decent titles on the SMS, such as *Alex Kidd in Miracle World* and *Alex Kidd in Shinobi World*. The *Zillion* and *Wonder Boy* titles were some of the best side-scrolling action games on the system. See Figures 5.12 and 5.13 for box artwork. Tragically, just over a third of the Master System's 300+ games were ever released in the United States.

■ ATARI 7800 PROSYSTEM

Initially called the Atari 3600, the **Atari 7800 ProSystem** (Figure 5.14) was developed by **General Consumer Corporation (GCC)** to replace the unsuccessful Atari 5200 before the Nintendo Famicom was ever released. The system was delayed when Atari was sold to former Commodore head **Jack Tramiel** and did not receive a full launch (often called a relaunch) until May 1986 at the competitive price of $139.

The console looked like a combination of the newly designed **Atari 2600 Jr.** and the Atari 5200 and was appropriately named the "7800" because of its 5200 graphics power + 2600 **backward compatibility** (ability to play 2600 games). Even the joystick appeared to be a hybrid between the 2600 and 5200 controllers. Gone was the confusing number pad from the 5200 controller and the joystick was self-centering again like the 2600's stick. The **Proline controller** (Figures 5.14 and 5.16) had just two buttons, as it was designed to be comfortable for both right-handed and left-handed players.

Like Nintendo's 10NES lockout chip, the 7800 also contained technology to maintain quality control of its software. "The solution was a unique and encrypted **digital signature** contained in all cartridges, that when not present would automatically lock the system into 2600 mode" (Retro Gamer, 2010, p. 229). Unlike European games, all 7800 games released in the United States required this digital signature code by Atari to operate. Similar to many of the previous second generation consoles, the 7800 Pro System was originally planned to be upgradable to a home computer. A keyboard was even developed, but the project never came to fruition.

The 7800 had a greater selection of launch titles (Table 5.4) compared to the Master System, although it could never compete with the NES library in terms of quality or quantity. Compared to Nintendo's original lineup, most of the 7800 games were just enhanced **ports** of arcade games that were already playable on the 2600 and/or 5200. The graphics were better than the older Atari consoles, but most players were more interested in newer titles they had not experienced yet. Furthermore, Nintendo was providing titles that were exclusive to the home market—games that could not be played in the arcades.

TABLE 5.4 Atari 7800 ProSystem U.S. Launch Titles

- Ms. Pac-Man
- Pole Position II (Figure 5.15a)
- Centipede
- Joust (Figure 5.15b)
- Dig Dug
- Desert Falcon
- Robotron: 2084
- Galaga
- Xevious
- Food Fight
- Ballblazer
- Rescue on Fractalus!
- Track and Field

FIGURE 5.14 Atari 7800 ProSystem with a Proline joystick controller.

FIGURE 5.15 Screenshots from Atari 7800 launch titles (a) *Pole Position II* and (b) *Joust.*

(a)

(b)

To its credit, the 7800 was one of the first consoles to contain backward compatibility with its ability to play 2600 titles. Interestingly, the 7800 could play Atari 2600 games but not Atari 5200 games. This was because the system included the 2600's **TIA (Television Interface Adaptor)** graphics and sound chip, but did not include the chips from the less popular 5200.

■ CONSOLE COMPARISON: ATARI 7800 VERSUS NES

The 7800's 8-bit 6502C **"SALLY" processor** clocked in at **1.79 MHz** Table 5.5 which was identical to the speed of Nintendo's Ricoh processor. Where it differed most was in its custom graphics chip called **MARIA** (combined with the TIA = TIA-MARIA, named after the Jamaican coffee liqueur). This chip was drastically different from the other consoles of the third generation in that it could display a larger number of sprites on screen—although doing so would often halt the CPU. And while it could move large graphics around on the screen, it was not as adept at handling side scrolling games like *Super Mario Bros.* The 7800 utilized **4 KB of RAM** and **4 KB of BIOS ROM** and its games were capable of being displayed at **160 × 240** or **320 × 200 pixels**—the latter being higher than the NES's 256 × 240 resolution. Capability aside, most 7800 games were programmed to run at the lower resolution to accommodate the processing demands of MARIA.

On-screen colors were about equal to the NES (**25 on-screen colors** versus Nintendo's 24); however, the 7800 had a much larger color palette to choose from with **256 total colors** versus the NES's palette of 52 colors. It was sound limitations that crippled the 7800 from the beginning more than anything else. At only **two channels of mono sound**, Atari 7800 games did not sound much better than 2600 games unless the cartridges included a **Pot Keyboard Integrated Circuit (POKEY) audio chip**, which used software to improve the sound of the game. Unfortunately, some of its best games, including *Pole Position II*, did not contain the POKEY audio chip and suffered from poor sound quality. Comparing the technical specifications of all three third-generation consoles found the Atari 7800 in a distant third place behind the NES and SMS.

TABLE 5.5 Atari 7800 ProSystem Tech Specs

Manufacturer:	Atari
Launch Price:	$139.99
Release Date:	May 1986 (US), 1987 (EU)
Format:	Cartridge (32K)
CPU:	8-bit 6502C "SALLY" processor (1.79 MHz)
Memory:	4 KB RAM, 4 KB BIOS ROM
Resolution:	160 × 240 or 320 × 200 pixels
Colors:	25 from a palette of 256
Sound:	2 channel mono

FIGURE 5.16 Comic book advertisement for the Atari 7800 (1990).

FIGURE 5.17 Box art to five of the top 7800 titles including: (a) *Alien Brigade,* (b) *Dark Chambers,* (c) *Food Fight,* (d) *Midnight Mutants*, and (e) *Ninja Golf*

(a) (b) (c) (d) (e)

HEAD-TO-HEAD

To compare the graphics and sound between the 7800 and NES, try (or watch video clips of) *Donkey Kong, Commando, Ikari Warriors, Xenophobe*, and *Xevious*. To compare the 7800 with both the NES *and* SMS, check out *Double Dragon* and *Rampage*.

■ KEY ATARI 7800 TITLES

One of the slogans used by Atari to market the 7800 was, "We Reinvented the Video Game." Perhaps a more appropriate slogan could have been, "We Reinvented Our Video Games," as most of the games on the 7800—especially in the beginning—were just upgraded versions of older titles already available on previous systems. Still, some of the updated classics attracted gamers for their nostalgic value and improved graphics, such as with notable upgrades of *Joust* and *Centipede*. *Alien Brigade*, *Midnight Mutants*, and *Ninja Golf* (shown in Figure 5.17) were solid console exclusives. Fewer than 100 games were ever developed for the system, but it did at least spawn more exclusive titles than the Atari 5200.

■ THIRD-GENERATION MARKET SUMMARY

If Atari was in hot water before the release of the 7800, they were in scorching lava afterward. When the company was sold to Jack Tramiel, rights of patents, licenses, and products were divided between the coin-op (arcade) division **Atari Games** and between **Warner Communications**, with Warner maintaining ownership of the 7800 Pro System. Arguments between Warner and Tramiel over who should pay General Consumer Corporation for their work on the 7800 and its launch titles ensued, with Tramiel reluctantly absorbing the bill in May 1985 (Retro Gamer, 2010, p. 231). The 7800 sold millions more units than the 5200, but by the end of the third generation, Atari had clearly lost the video game market it once dominated.

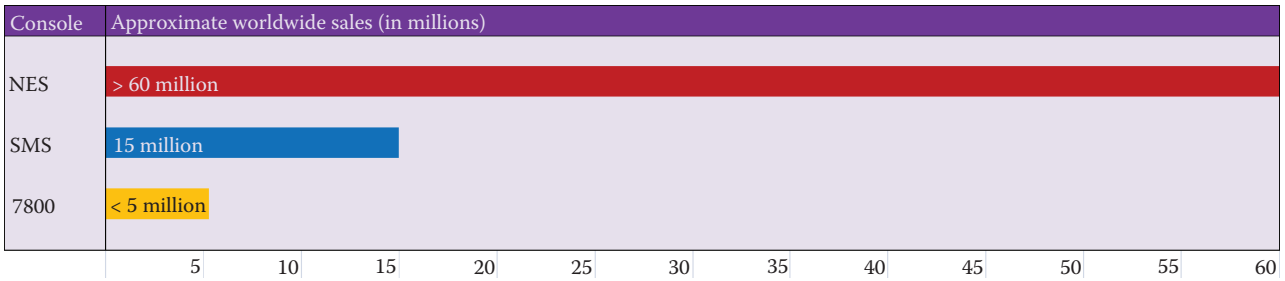
Sega originally planned to sell between 400,000 and 750,000 Master System consoles (Takiff, 1986), but by the end of 1986 the SMS had sold just 125,000 consoles—more than the Atari 7800's 100,000 but far less than Nintendo's 1.1 million (Computer Entertainer, 1987, p. 13). Unlike in Japan and North America where Nintendo focused its efforts, the Master System outsold the NES in Europe by a considerable margin (Screen Digest, 1995, p. 61). It also sold well in Brazil when it launched in 1989 and lasted for many years in South America where it saw many exclusive titles. Success in other countries combined with a profitable coin-op business in the arcades kept Sega afloat. These victories would help Sega become a major player in the next generation.

The NES sold the most units in the third generation due to its earlier initial release, strong first-party titles, and Nintendo's strict licensing policy with third party developers. By 1988, Nintendo commanded an 83% share of the North American video game market (McGill, 1988) and at least 90% of the Japanese video game market. That same year, Sega handed the Master

System over to **Tonka** for distribution until they reacquired distribution rights for the redesigned **Master System II**. Nintendo's effect on American culture was so profound that "a 1990 survey showed that Mario was more recognized by children than Mickey Mouse" (Diskin, 2004, p. 4).

Figure 5.18 illustrates how many millions of consoles were eventually sold. Nintendo's success with the Famicom and NES signaled a significant market shift in the video game industry. "Much development in the arcades had switched to Japan, and with Nintendo's Famicom the clear market leader there, it had a lock on the latest titles" (Retro Gamer, 2010, p. 231). This market change saw Japan as the dominant force in the video game industry—a crown that the country would hold for generations.

FIGURE 5.18 Third-generation console sales graph.



■ THIRD-GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the third generation of video games. Here is a list of the top 10 advancements that defined the generation:

1. D-pad game controllers
2. Tile-based playfields with smooth hardware scrolling
3. The "platformer" style video game
4. Detailed sprite graphics with integer sprite zooming (to double sprite size)
5. Higher screen resolutions (up to 256 × 240 and 320 × 200 pixels)
6. Multi-directional scrolling and diagonal scrolling
7. Enhanced sound (up to 5-channel mono audio)
8. Battery backup save feature (where progress could be saved to the cartridge)
9. Light gun game popularity
10. Active-shutter stereoscopic 3D glasses

■ ACTIVITY: ARCADE TO HOME PORT COMPARISON

Play or screen gameplay from an arcade title and its home port for at least 30 minutes each. Take notes on the graphical, aural, and gameplay differences and similarities.

SUGGESTED TITLES

Compare the arcade version with the NES version of *Ikari Warriors, Punch-Out!!,* or *Splatterhouse;* the Sega Maser System version of *Space Harrier, Double Dragon,* or *Shinobi;* and/or the Atari 7800 version of *Pole Position II, Joust,* or *Xevious*.

GUIDELINES

Always begin by playing/viewing the arcade version of the game; then discuss how the home port measures up. Then write a 500- to 1000-word comparison essay comparing the two games in regard to:

- Graphics – include size and scale, color palette, resolution (clarity), animation, effects, and presentation.
- Sound – include the quality and accuracy of the games' music and sound effects.
- Playability – include how well the games control and how fun they are to play.

QUESTIONS

1. How do these games compare to arcade ports from the previous generation?
2. Did the home console version add anything to or lack anything important from the arcade experience?
3. Do you feel that the console version was close enough to the arcade game that players would rather purchase the game and play from home?
4. Did the arcade version contain any features that would still attract gamers to an arcade venue to play the game?
5. What impact do you think this had on the arcade industry, if any?
6. Could the publisher/developer have done anything differently?
7. What are your final thoughts?

■ CHAPTER 5 QUIZ

1. Which company was *not* a leading arcade game publisher in the mid-1980s?
   a. Capcom
   b. Cave
   c. Konami
   d. Taito

2. Which third-generation console sold the largest number of units?
   a. Nintendo Entertainment System
   b. Sega Master System
   c. Sega SG-1000
   d. Atari 7800

3. Nintendo's Famicom stood for:
   a. Family Computer
   b. Future Computer
   c. Family Console
   d. Future Console

4. What system launched with a bad chip that caused a product recall and reissue with a new motherboard?
   a. Atari 2600
   b. Nintendo Famicom
   c. Sega Master System
   d. Atari 7800

5. Nintendo initially approached _____ to market and distribute the NES in the United States.
   a. Atari
   b. Coleco
   c. Mattel
   d. Tonka

6. In which U.S. city was the NES first released?
   a. Boston
   b. New York City
   c. Miami
   d. Los Angeles

7. The original mascot for the NES was a robot named R.O.B. which stood for:
   a. Robot Opponent Buddy
   b. Robot Operating Buddy
   c. Robot Operating Bus
   d. Random Operating Bus

8. What creation(s) is Shigeru Miyamoto famous for?
   a. Donkey Kong
   b. Legend of Zelda
   c. Super Mario Bros.
   d. All of the above

9. SEGA stands for:
   a. Service Games
   b. Sonic Electronic Games of America
   c. Super Electronic Games of America
   d. Solid Electronic Games of America

10. The typical launch price for an NES or a Master System video game console was:
    a. $299.99
    b. $249.99
    c. $199.99
    d. $99.99

11. Which console was *not* redesigned for the American audience?
    a. Nintendo Famicom
    b. Nintendo Advanced Video System
    c. Sega Mark III
    d. Atari 7800

12. Which console was technologically superior based on tech spec numbers?
    a. Nintendo Entertainment System
    b. Sega Master System
    c. Sega SG-1000
    d. Atari 7800

13. The Atari 7800 ultimately failed to obtain long-term market success because of:
    a. Poor hardware sound
    b. Dated initial game library
    c. Divided patents, licenses, and product rights
    d. All of the above

14. One of Sega's marketing slogans for the Master System was:
    a. "The Challenge Will Always Be There"
    b. "Now You're Playing With Power"
    c. "We Reinvented the Video Game"
    d. All of the above

15. The Sega Master System was a commercial failure in most countries, except for:
    a. Japan and Europe
    b. Japan and Brazil
    c. Brazil and Europe
    d. Brazil and the United States

16. Which feature was not part of the major three third-generation consoles?
    a. 16-bit graphics
    b. Battery backup save feature (where progress could be saved to the cartridge)
    c. Light gun game popularity
    d. Active-shutter stereoscopic 3D glasses

True or False

17. The original Nintendo Famicom launch titles were *Super Mario Bros.* and *Duck Hunt*.

18. The Famicom console was renamed the Advanced Video System (AVS), before being renamed the Nintendo Entertainment System (NES) for the U.S. market.

19. R.O.B. never saw another game beyond *Gyromite* and *Stack-Up*. The robot was unpopular in both the United States and Japan and was eventually discontinued.

20. Two of the key video game titles the NES included were *Metroid* and *Mega Man 2*.

■ FIGURES

FIGURE 5.1 Atari still delivered defining arcade games after the Video Game Crash of 1983, including (a) Paperboy (1984), (b) Marble Madness (1984), and (c) Gauntlet (1985). (*Marble Madness* courtesy of Atari, 1984; *Gauntlet* courtesy of Atari, 1985; and *Out Run* courtesy of Sega, 1986.)

FIGURE 5.2 "Famicom-Console-Set" By Evan Amos. Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=19135654. Retrieved from https://commons.wikimedia.org/wiki/File:Famicom-Console-Set.png#/media/File:Famicom-Console-Set.png. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=19135654. Retrieved from https://commons.wikimedia.org/wiki/File:Famicom-Console-Set.png#/media/File:Famicom-Console-Set.png. "Famicom-Console-Set").

FIGURE 5.3 Screenshots of Famicom launch titles (from left to right): (a) *Donkey Kong* (Nintendo, 1983), (b) *Donkey Kong Jr.* (Nintendo, 1983), and (c) *Popeye* (Nintendo, 1983). (Courtesy of Nintendo, 1983.)

FIGURE 5.4 "Nintendo Advanced Video System (retouched)" By Russell Bernice and Chris Donlan ("Doonvas"), CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=31293613. Retrieved from https://commons.wikimedia.org/wiki/File:Nintendo_Advanced_Video_System_(retouched).jpg#/media/File:Nintendo_Advanced_Video_System_(retouched).jpg. (Courtesy of Russell Bernice and Chris Donlan ("Doonvas"), CC BY 2.0. Available at https://commons.wikimedia.org/w/index.php?curid=31293613 Retrieved from https://commons.wikimedia.org/wiki/File:Nintendo_Advanced_Video_System_(retouched).jpg#/media/File:Nintendo_Advanced_Video_System_(retouched).jpg).

FIGURE 5.5 "NES-Console-Set" By Evan Amos. Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=11408666 Retrieved from https://commons.wikimedia.org/wiki/File:NES-Console-Set.png#/media/File:NES-Console-Set.png (part of this image was also used on the introductory page of this chapter). ("The Complete 1986 CES NES Brochure For Your Viewing Pleasure" Posted Mon 3 September 2012 by Damien McFerran. Retrieved from http://www.nintendolife.com/news/2012/09/the_complete_1986_ces_nes_brochure_for_your_viewing_pleasure).

FIGURE 5.6 "The Complete 1986 CES NES Brochure For Your Viewing Pleasure." Posted Mon September 3, 2012 by Damien McFerran. Retrieved from http://www.nintendolife.com/news/2012/09/the_complete_1986_ces_nes_brochure_for_your_viewing_pleasure. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11408666. Retrieved from https://commons.wikimedia.org/wiki/File:NES-Console-Set.png#/media/File:NES-Console-Set.png. Part of this image was also used on the introductory page of this chapter.)

FIGURE 5.7 Screenshots from NES launch titles (a) *Kung Fu* (Irem/Nintendo, 1985) and (b) *Super Mario Bros.* (Nintendo, 1985). (*Kung Fu* courtesy of Irem/Nintendo, 1985; and *Super Mario Bros.* courtesy of Nintendo, 1985.)

FIGURE 5.8 Box art to five prestigious NES titles displaying the Nintendo Seal of Quality including from left to right: (a) *Super Mario Bros.* (Nintendo, 1985), (b) *Contra* (Konami, 1988), (c) *The Legend of Zelda* (Nintendo, 1987), (d) *Mega Man 2* (Capcom, 1989), and (e) *Metroid* (Nintendo, 1987). (*Super Mario Bros.* courtesy of Nintendo, 1985; *Contra* courtesy of Konami, 1988; The Legend of Zelda courtesy of Nintendo, 1987; *Mega Man 2* courtesy of Capcom, 1989; and *Metroid* courtesy of Nintendo, 1987.)

FIGURE 5.9 (a) "Sega-SG-1000-Console-Set" By Evan Amos. Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18273359. Retrieved from https://commons.wikimedia.org/wiki/File:Sega-SG-1000-Console-Set.jpg#/media/File:Sega-SG-1000-Console-Set.jpg and (b) "Sega Mark III" By Muband. Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=9038926. Retrieved from https://commons.wikimedia.org/wiki/File:Sega_Mark_III.jpg#/media/File:Sega_Mark_III.jpg. (Left: Courtesy of Evan-Amos - Own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18273359. Retrieved from https://commons.wikimedia.org/wiki/File:Sega-SG-1000-Console-Set.jpg#/media/File:Sega-SG-1000-Console-Set.jpg. "Sega-SG-1000-Console-Set". Right: Courtesy of Muband - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=9038926. Retrieved from https://commons.wikimedia.org/wiki/File:Sega_Mark_III.jpg#/media/File:Sega_Mark_III.jpg. "Sega Mark III")

FIGURE 5.10 "Sega-Master-System-Set" by By Evan Amos. Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=14249084. Retrieved from https://commons.wikimedia.org/wiki/File:Sega-Master-System-Set.jpg#/media/File:Sega-Master-System-Set.jpg (part of this image was also used on the introductory page of this chapter). ("The Sega Master System's Hot This Summer" posted by Retroist. Retrieved from http://www.retroist.com/2011/01/27/the-sega-master-systems-hot-this-summer/)

FIGURE 5.11 Screenshots from Sega's two U.S. launch titles (a) *Hang-On* (Sega, 1985) and (b) *Safari Hunt* (Sega, 1986). (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14249084. Retrieved from https://commons.wikimedia.org/wiki/File:Sega-Master-System-Set.jpg#/media/File:Sega-Master-System-Set.jpg. Part of this image was also used on the introductory page of this chapter.)

FIGURE 5.12 Magazine advertisement for the Sega Master System in 1990. "*The Sega Master System's Hot This Summer*" posted by *Retroist*. Retrieved from http://www.retroist.com/2011/01/27/the-sega-master-systems-hot-this-summer/. (*Hang-On* courtesy of Sega, 1985; and Safari Hunt courtesy of Sega, 1986.)

FIGURE 5.13 Box art to five standout SMS titles including from left to right: (a) *Phantasy Star* (Sega, 1988), (b) *Shinobi* (Sega, 1988), (c) *Wonder Boy in Monster World* (Westo One/Sega, 1993, published by Sega), (d) *Alex Kidd in Miracle World* (Sega, 1986), and (e) *Zillion* (Sega, 1987). (*Phantasy Star* courtesy of Sega, 1988; *Shinobi* courtesy of Sega, 1988; *Wonder Boy in Monster World* courtesy of Westo One/Sega, 1993, published by Sega; Alex Kidd in *Miracle World* courtesy of Sega, 1986; and *Zillion* courtesy of Sega, 1987.)

FIGURE 5.14 "Atari-7800-Console-Set" By Evan Amos. Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18312472. Retrieved from https://commons.wikimedia.org/wiki/File:Atari-7800-Console-Set.png#/media/File:Atari-7800-Console-Set.png (part of this image was also used on the introductory page of this chapter). (Courtesy of Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18312472. Retrieved from https://commons.wikimedia.org/wiki/File:Atari-7800-Console-Set.png#/media/File:Atari-7800-Console-Set.png. Part of this image was also used on the introductory page of this chapter.)

FIGURE 5.15 Screenshots from Atari 7800 launch titles (a) *Pole Position II* (Atari, 1987) and (b) *Joust* (Atari, 1986). (*Pole Position II* courtesy of Atari, 1987; and *Joust* courtesy of Atari, 1986.)

FIGURE 5.16 Comic book advertisement for the Atari 7800 (1990). Retrieved from Atari Age at http://atariage.com/forums/topic/168431-a-few-more-vintage-atari-7800-print-ads/.

FIGURE 5.17 Box art to five top 7800 titles including from left to right: (a) *Alien Brigade* (Sculptured Software/Atari, 1990), (b) *Dark Chambers* (Sculptured Software/Atari, 1988), (c) *Food Fight* (Atari, 1990), (d) *Midnight Mutants* (Radioactive Software/Atari, 1990), and (e) *Ninja Golf* (Blue Sky Software/Atari, 1990). (*Alien Brigade* courtesy of Sculptured Software/Atari, 1990; *Dark Chambers* courtesy of Sculptured Software/Atari, 1988; *Food Fight* courtesy of Atari, 1990; *Midnight Mutants* courtesy of Radioactive Software/Atari, 1990; and *Ninja Golf* courtesy of Blue Sky Software/Atari, 1990.)

FIGURE 5.18 Third-generation console sales graph. Designed by Wardyga using data from Resource Site for Video Game Research, "Console Wars through the Generations." http://dh101.humanities.ucla.edu/DH101Fall12Lab4/graph—console-wars. (Designed by Wardyga using data from Resource Site for Video Game Research, "Console Wars through the Generations." Available at http://dh101.humanities.ucla.edu/DH101Fall12Lab4/graph—console-wars)

Pro File: Sigeru Miyamoto. Photo credit: Shigeru Miyamoto at E3 2013. Photo by Jan Graber via Public Domain CC BY-SA 3.0 de, https://commons.wikimedia.org/w/index.php?curid=57040765.

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The 16-bit Era

OBJECTIVES

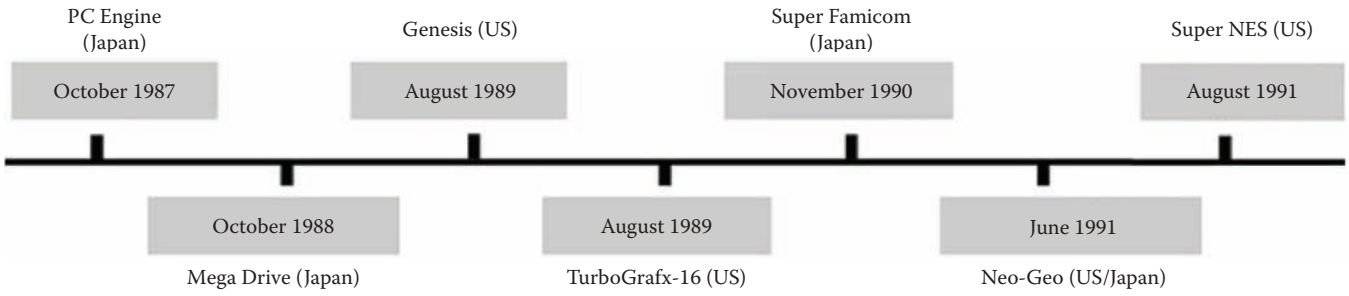
After reading this chapter, you should be able to:

- Compare fourth-generation consoles with their 8-bit predecessors.
- Have a sense of graphics and other capabilities of fourth-generation games.
- Be familiar with the technological differences among fourth-generation consoles.
- Describe how Japanese consoles were redesigned for the American audience.
- List some of the key video game titles and peripherals for each console.
- Recognize the importance the new technology had on the video game industry.
- Describe how and when Sega rose above Nintendo during the fourth generation.
- Summarize a brief overview of the history of NEC and SNK.
- Explain why Sega and Nintendo were the dominant 16-bit consoles in the United States.
- List several innovations introduced to gaming during this time period.
- Summarize fourth-generation market sales, breakthroughs, and trends.

■ KEY TERMS AND PEOPLE

16-bit
3D polygons
Atari Lynx
Lance Barr
Blast processing
Capcom
Censorship
Central Processing Unit
Color layering
Compile
Console war
Digital Signal Processor
Direct Memory Access
Electronic Arts
Full Motion Video (FMV)
Game Boy
Game Gear
Genesis
Graphics Processing Unit
Ben Herman
HuCards/TurboChips
Hudson Soft
Masami Ishikawa
Tom Kalinske
Michael Katz
Yuzo Koshiro
Konami
Localization
Mega Drive
Menacer
Mode 7
Mosaic
Motorola 68000
Yuji Naka
Hayao Nakayama
Neo•Geo Advanced Entertainment System
Neo•Geo CD/CDZ
Neo•Geo MVS
Nippon Electric Company
Naoto Ohshima
Parallax scrolling
PC Engine
Power Base Converter
Region protection
Reprogramming
Rotation
Kent Russell
Hideki Sato
Scaling
Sega CD
Sega R&D Team
Sega Virtua Processor
Shin Nihon Kikaku (SNK)
Shoot'em ups/shmups
Slowdown
Sonic the Hedgehog
Street date
Street Fighter II
Super Famicom
Super Nintendo
Super Scope
SuperFX chip
SuperGrafx
Yu Suzuki
TurboDuo
TurboExpress
TurboPad
TurboGrafx-16
TurboGrafx-CD
TurboTap
Masayuki Uemura
VRAM bandwidth
Western Electric Company
Zilog Z80

■ CONSOLE TIMELINE



■ ARCADE REVIVAL

The graphics and sound of arcade games remained superior to home consoles. Sega's motion-controlled, hydraulic cabinets by Director/Designer **Yu Suzuki** led to games like *OutRun* (1986) and *After Burner* (1987), which provided a level of immersion that could not be experienced in the home. Companies like Sega and Capcom introduced refined titles to the "beat'em up" genre with games like *Golden Axe* and *Final Fight* in 1989—and a slew of other similar titles would follow. After a decline in the 1980s, the arcade industry began to enter a resurgence period after bottoming out around 1991.

The game that brought people back to the arcades more than any other was Capcom's *Street Fighter II: The World Warrior* (1991) (Compton, 2004, p. 119). This head-to-head fighting game featured six buttons (for light, medium, and heavy punches and kicks) and each character had a number of unique special moves and attack combinations to be learned. As complex as the game was, it revived the arcade industry during this time and popularized the fighting game genre (see Figure 6.1). Titles like Midway's *Mortal Kombat* (1992) and a plethora of other fighting series (including *Fatal Fury, World Heroes, Samurai Shodown*, and *The King of Fighters*) would follow its success.

3D polygon graphics also started to appear during this time, with games like Atari's *Hard Drivin'* (1989) and Sega's *"Virtua"* series by Yu Suzuki. On the other hand, market inflation and rising manufacturing costs resulted in many arcade cabinets beginning to require two or more quarters/tokens (or multiple coins to start the game and one quarter for each continue) to turn a profit. Similar to the second generation, people wanted to bring the arcade experience home and many of the best-selling home video games in the early 1990s were ports of popular arcade games.

■ THE 16-BIT ERA: NEC PC ENGINE

Often referred to as the "16-bit era," the fourth generation of video games began in Japan with the **PC Engine** (Figure 6.2) by **Nippon Electric Company (NEC)**. The company was established by Kunihiko Iwadare and Takeshiro Maeda on August 31, 1898. On July 17, 1899 Nippon Electric Company, Ltd. and **Western Electric Company** became the first Japanese joint-venture with foreign capital (Mason, 1987, p. 95). The company began as a telephone and switch manufacturer and over the decades expanded its business to include radio, telecommunications, and computers. Success in the computer industry during the 1980s led to NEC licensing technology from video game manufacturer **Hudson Soft** to create their first video game console, the PC Engine.

The PC Engine launched in Japan on October 30, 1987 for ¥24,800 (approximately $208 USD). It was initially developed to compete with the Famicom/NES, but found its greatest competition with later fourth-generation offerings by Sega and Nintendo. The console featured only one controller port and launched with just two titles: *Bikkuriman World* and *Shanghai*. Like the rarely seen 8-bit Sega Cards, the PC Engine's games (called **HuCards**) were similar in size to a credit card.

FIGURE 6.1 Defining arcade fighting games in the fourth generation: (a) *Street Fighter II* (1991), (b) *Mortal Kombat* (1992), and (c) *Virtua Fighter* (1993).

(a) (b) (c)

PRO FILE

KEY FACTS:

The arcade pioneer who led the 'Taikan' trend of using motion-controlled hydraulic arcade cabinets and also pioneered 3D polygonal arcade games.

YU SUZUKI

PRO FILE

HISTORY:

- Born: June 10, 1958
Kamaishi, Iwate, Japan

EDUCATION:

- Degree in Electronic Science from Okayama University of Science

CAREER HIGHLIGHTS:

- Joined Sega Enterprises in 1983
- Hang On and Space Harrier (1985) Director/Designer
- OutRun (series) Director/Designer
- After Burner (1987) Director/Designer
- Virtua Racing (1992) Director/Chief Programmer
- Virtua Fighter (series) Director/Producer
- Virtua Cop (1994) Producer/Supervisor
- Shenmue (series) Director/Producer

RECOGNITION:

- Suzuki was the sixth person inducted into the Academy of Interactive Arts and Sciences' Hall of Fame in 2003

FIGURE 6.2 NEC PC Engine and PI-PD001 controller.

DID YOU KNOW?

The ultra-small PC Engine was the "first console to have a 16-bit graphics chip" (Guinness World Records, 2008, p. 26).

The system's casing was also ultra-compact, "with dimensions of 135 × 130 × 35 mm [or 5.3 × 5.1 × 1.37 inches], it remains the smallest home console ever made" (McFerran, 2012, para. 4). The PC Engine sold quite well in Japan during its first year and "more Japanese consumers purchased PC Engines in 1988 than Famicoms" (Kent, 2001, p. 411). In less than two years after its Japanese launch, the system was redesigned and launched in the United States as the **TurboGrafx-16** (Figure 6.3).

■ TURBOGRAFX-16

The TurboGrafx-16 debuted in the United States on August 29, 1989 for $199. Its redesign featured the "bigger is better" mentality, which was believed to be more attractive to U.S. consumers. However, even with a larger casing, the TG-16 was just a PC Engine in disguise and still only contained a single controller port. The HuCards were renamed **"TurboChips"** and just about every peripheral was renamed to include the word "Turbo" in

FIGURE 6.3 NEC TurboGrafx-16 console with TurboPad controller.

TABLE 6.1 NEC TubroGrafx-16 U.S. Launch Titles

- Alien Crush
- China Warrior
- Dungeon Explorer
- Keith Courage in Alpha Zones (Figure 6.4a)
- Power Golf
- R-Type (Figure 6.4b)
- The Legendary Axe
- Victory Run
- Vigilante

the title. To play with more than one controller, consumers had to spend an additional $18 to $20 for a **"TurboTap"** peripheral. The TurboTap (a precursor to the NES's "Four Score") allowed up to five controllers to be plugged into the system.

One unique feature of the **TurboPad controller** was the inclusion of **turbo switches** above the two action buttons. When switched on, just holding down the action buttons would simulate rapid button pressing by the player. This feature (first seen on the NES Advantage joystick) made certain games (such as space shooters) without rapid fire much less fatiguing to play. Unlike the Nintendo Entertainment System and Sega Master System that came before it, the TurboGrafx-16 did not have a light gun peripheral.

The TG-16 came bundled with the side-scrolling action game *Keith Courage in Alpha Zones*. The game showcased the console's high color palette, but was a pretty mediocre title beyond its graphics. The TG-16 had many respectable launch titles (Table 6.1), which were of both high quality and variety. One of the biggest issues with the TG-16 was **localization**, adapting its Japanese PC Engine games for U.S. release. Whether from licensing/copyright conflicts or NEC's focus on the Japanese market, well over half of the PC Engine's titles never reached American shores. Advertising was also not given the same amount of support dollars that Sega and Nintendo would eventually dish out for their 16-bit systems.

Shortly after the TurboGrafx-16 was launched in the United States, NEC began to release more powerful versions of the console, including a CD add-on (shown in Figure 6.5). The first new version was an enhanced PC Engine called the **SuperGrafx**, which was released exclusively in Japan. The system contained about four times the amount of RAM as the regular system, but only a handful of titles were ever released for it. More successful than the SuperGrafx was the PC Engine's CD-ROM² (pronounced "CD-ROM-ROM").

The CD-ROM² was the **first CD-ROM** add-on (expansion) unit for a video game console. It released as the **TurboGrafx-CD** in the United States on August 1, 1990 for $399 without a pack-in title. TG-CD games were capable of full speech dialog and high-quality music since CD-ROMs "could store nearly 260 times more data than TurboGrafx [TurboChip] cards" (Kent, 2001, p. 413).

FIGURE 6.4 Screenshots of TG-16 launch titles (a) *Keith Courage in Alpha Zones* and (b) *R-Type*.

(a)

(b)

FIGURE 6.5 The NEC SuperGrafx (Japan), (a) TurboGrafx-CD add-on connected to a TurboGrafx-16 console (b), and the TurboDuo combo system (c).

(a) (b) (c)

Unlike the HuCards and TurboChips (shown in Figure 6.6), there was no **region protection** on TurboGrafx-CD and CD-ROM² games. This meant that games released exclusively in Japan could be played on U.S. systems and vice versa. Many of the best CD-ROM² import titles contained all-Japanese text and/or language, however, making many games difficult or impossible for most U.S. consumers to play.

NEC later released a portable version of the TG-16 called the **TurboExpress** for $249, which played all TG-16 games and featured a TV tuner add-on. There was also the **TurboDuo**, which combined the CD-ROM add-on and TurboGrafx-16 into one unit for just $299. By this point, however, NEC would begin to slip into a distant third place in the U.S. video game market behind Sega and Nintendo.

■ CONSOLE COMPARISON: TURBOGRAFX-16 VERSUS NES

The TurboGrafx-16 launched at the same price as the NES nearly four years earlier. While both systems contained 8-bit CPUs, TG-16's **8-bit Hu6820 processor** (7.6 MHz) (Table 6.2) packed much more speed compared to the NES's 8-bit Ricoh 6502 processor (1.79 MHz).

The TG-16 was capable of displaying games with a **512 × 224** pixel resolution; however, most of its titles were programmed at **256 × 239**—about the same resolution as the NES.

Resolution aside, the TG-16's **16-bit GPU** was better at handling **larger sprites** and its high **color palette** gave its graphics a huge advantage. The TG-16 was capable of displaying a whopping **482 colors on-screen**, compared to the NES's paltry 24 on-screen color capacity. Sound and music were also much cleaner on the TG-16.

Part of the marketing strategy in the fourth generation was to differentiate from the previous generation by emphasizing the newer consoles' technical superiority. The buzz word of the fourth generation was **"16-bit."** Prior to this generation, most gamers never even spoke about "bits" or other technical specifications of their consoles. One popular dispute was whether the TurboGrafx-16 was a true 16-bit system. The console was marketed as a 16-bit system, but the TG-16 was really powered by an ***8-bit*** **central processing unit (CPU)** with a dual ***16-bit*** **graphics processing unit (GPU)**.

■ KEY TURBOGRAFX-16 TITLES

Less than a quarter of the estimated 650 PC Engine titles ever made it to U.S. retailers, but the TurboGrafx-16 still had a number of solid titles worth checking out. Bonk from *Bonk's Adventure* became a mascot for the system, spawning three side scrolling adventures. *Blazing Lazers* was an enjoyable vertical shooter developed by **Compile**, who became known for its shooters (known as shoot'em ups or "shmups") during this period.

Military Madness helped pave the way for real-time and turn-based strategy games. *Splatterhouse* caught gamers' attention with its lead character's resemblance to Jason from the *Friday the 13th* movies, while the pinball title *Alien Crush* had the organic look of the

FIGURE 6.6 Magazine advertisement for the TurboGrafx-16 in November 1992.

FIGURE 6.7 Box art to five defining TurboGrafx-16 titles including: (a) *Blazing Lazers*, (b) *Military Madness*, (c) *Splatterhouse*, (d) *Bonk's Adventure*, and (e) *Neutopia*.

(a) (b) (c) (d) (e)

movie *Alien*. Similar to how Electronic Arts designed its computer software packaging after vinyl records, TG-16 titles (Figure 6.7) were essentially packaged in CD jewel cases with a modified interior to hold the TurboChip game cards. TG-16 games had plenty of style, however, many of them lacked the overall depth of NES favorites such as *Super Mario Bros.*, *Zelda*, and *Metroid*.

HEAD-TO-HEAD

To compare the graphics and sound between the TurboGrafx-16 and NES, see each system's version of *Adventure Island*, *Bomberman*, and *Jackie Chan's Action Kung Fu*.

TABLE 6.2 NEC PC Engine/TG-16 Tech Specs

Manufacturer:	NEC & Hudson Soft
Launch Price:	$199.99
Release Date:	10/30/87 (JP), 8/29/89 (US), 11/22/89 (EU)
Format:	TurboChip (called "HuCard" in Japan)
CPU:	8-bit Hu 6820 processor (7.6 MHz)
Memory:	8 KB work RAM, 64 KB video RAM
Resolution:	256 × 239, 336 × 239, and 512 × 224
Colors:	482 from a palette of 512
Sound:	6 channel wavetable synthesis

■ SEGA MEGA DRIVE

Shortly after the release of the PC Engine in Japan, Sega released its own 16-bit system on October 29, 1988—the Sega **Mega Drive**. "Mega" had the subtext of superiority, while "Drive" suggested both power and speed. To compete with the Famicom and PC Engine, Sega built its new machine "around the **Motorola 68000** processing chip, the same chip that Apple used to power the Macintosh computer" (Kent, 2001, p. 401). It also had a separate 8-bit processor for sound. The **Zilog Z80** was used as a secondary CPU to handle the sound to reduce the load on the main CPU (Sato, 2013).

The Mega Drive was developed by Sega's **R&D (Research and Development) team** supervised by **Hideki Sato** and **Masami Ishikawa**. It debuted at ¥21,000 (approximately $168 USD), and while technically superior to the Famicom and PC Engine, it failed to compete with either console in Japan. The system launched without an initial pack-in title and only *Space Harrier II* and *Super Thunder Blade* were available at launch. It also did not help Sega that *Super Mario Bros. 3* was released on Famicom just one week earlier.

Like with the Master System, one of Sega's promises with the Mega Drive was to bring the **arcade experience** home. As the first **true 16-bit** console, it could now deliver on that promise. Sega prepared a U.S. launch of the console for the following year.

HANDHELD SNAPSHOT: GAME BOY

The **Game Boy** (Figure 6.8) was created by **Satoru Okada** and Nintendo R&D1 team led by **Gunpei Yokoi**. The system launched in the United States on July 31, 1989 for just $89.95. The smaller **Game Boy Pocket** released in 1996. Even with its monochrome display, Game Boy became the most popular handheld system with interchangeable cartridges, selling tens of millions of units. The system's success has been attributed the pack-in title *Tetris* by Alexey Pajitnov, its low cost, and excellent battery life (McFerran, 2009, p. 148). See Table 6.3 for specs.

TABLE 6.3 Game Boy Tech Specs

Format:	Cartridge/4 AA batteries (up to 30 hours)
CPU:	8-bit Sharp LR35902 processor (4.19 MHz)
Memory:	8 KB SRAM, 8 KB video RAM
Resolution:	160 × 144 pixels/2.6" diagonal LCD screen
Colors:	4-level grayscale
Sound:	4-channel FM mono speaker with a 3.5 mm stereo jack

Its library of more than 1000 games played a major role in the handheld's success, with exclusive sequels/spinoffs from the *Castlevania, Mario, Metroid*, and *Zelda* franchises, along with the introduction of new Nintendo stars such as *Kirby* (seen in Figure 6.9) and *Wario*.

FIGURE 6.8 Nintendo Game Boy.

FIGURE 6.9 Box art to five top Game Boy titles: (a) *Kirby's Dream Land*, (b) *Super Mario Land 2: 6 Golden Coins*, (c) *Tetris*, (d) *The Legend of Zelda: Link's Awakening*, and (e) *Pokémon Yellow*.

(a) (b) (c) (d) (e)

■ SEGA GENESIS

Where the Mega Drive released a full year after the PC Engine in Japan, the Sega Genesis (Figure 6.10) beat the TurboGrafx-16 to the U.S. market by two weeks. Released on August 14, 1989 for $189, the Genesis came bundled with one controller and a port of the arcade game *Altered Beast*. The kidney bean-shaped controller may have been attractive to U.S. gamers as it accommodated larger hands. Its sleek design and action-oriented game library made the Sega Genesis an attractive console for the male teenage audience.

DID YOU KNOW?

Sega's 16-bit console was known as the Mega Drive just about everywhere else in the world except for the United States. The name was changed to Genesis due to a possible trademark dispute with U.S. storage devices manufacturer **Mega Drive Systems Inc.** (Sczepaniak, 2006, p. 45).

The Genesis launched with six available titles (Table 6.4), which was the largest selection of games out of the three Sega console launches. In about a month or less, four more titles were available, including *Ghouls 'n Ghosts, Arnold Palmer Tournament Golf, World Championship Soccer*, and *Super Hang-On*. To extend the Genesis library, Sega offered a $35 peripheral called the **Power Base Converter** (Figure 6.12a). The Power Base Converter plugged into the Genesis's cartridge slot and allowed the console to play Master System games.

TABLE 6.4 Sega Genesis U.S. Launch Titles

- Alex Kidd in Enchanted Castle
- Altered Beast (Figure 6.11a)
- Last Battle
- Space Harrier II (Figure 6.11b)
- Thunder Force II
- Tommy Lasorda Baseball

Sega's library of arcade game ports was not enough to push the Genesis to greatness in North America. It still had to overcome an initial deficit of third-party software support due to Nintendo's strict licensing policy that kept top developers like **Capcom** and **Konami** from developing for the system in the beginning. Until such third parties could develop games for the Genesis, Sega would often buy the rights to their games and **reprogram** the games for Genesis under the Sega name. Some examples of this include Capcom arcade hits *Forgotten Worlds, Ghouls 'n Ghosts*, and *Strider*.

Sega Enterprises CEO **Hayao Nakayama** hired **Michael Katz** (Intellivision, Coleco) as President of Sega of America just one month after the console's U.S.

FIGURE 6.10 Sega Genesis and 3-button controller (U.S.), which was the first console to release outside of Japan with nearly identical casing to its Japanese sibling (Mega Drive).

FIGURE 6.11 Screenshots from Genesis launch titles (a) *Altered Beast* and (b) *Space Harrier II*.

(a) (b)

release. His charge from Nakayama: *"Hyakumandai!"* (*"One million units!"* in Japanese). In an attempt to reach this goal, Katz led Sega toward producing a number of games endorsed by popular sports figures such as in early titles *Tommy Lasorda Baseball* and *Arnold Palmer Tournament Golf*. The result was a number of celebrity-endorsed games such as *Pat Riley Basketball, Joe Montana Football, James 'Buster' Douglas Knockout Boxing*, and *Michael Jackson's Moonwalker* (Figure 6.13). Ironically, it was **Electronic Arts** games like *John Madden Football, NHL Hockey*, and its own lineup of original sports titles that really helped the Genesis gain momentum.

The second contribution Katz made was perhaps Sega's most memorable advertising campaign. The first Genesis slogan was "We bring the arcade experience home." Katz and his team decided to attack Nintendo head-on and came up with the slogan **"Genesis does what Nintendon't"** (Fahs, 2009, p. 4). After 14 months, Katz was only able to help Sega sell a half-million units and was replaced by **Tom Kalinske** from Mattel. Kalinske's four-part strategy for the Genesis involved: (1) lowering the price of the console to $149 (and eventually $99), (2) creating a U.S. development team to make more U.S.-friendly games, (3) continuing to push Sega's aggressive advertising campaign, and (4) replacing *Altered Beast* as the pack-in title with its upcoming game, *Sonic the Hedgehog* (Kent, 2001, p. 427).

Probably due to their smaller market appeal, Sega did not release a light gun for the Genesis until 1992.

FIGURE 6.12 Two of the many Genesis add-ons: (a) Power Base Converter and (b) Sega CD.

(a) (b)

FIGURE 6.13 Magazine advertisement for the Sega Genesis in 1990.

The **Menacer** light gun peripheral was most likely created in response to the Nintendo **Super Scope,** which was released for the SNES the same year. In response to the Super Nintendo's 6-button controller, Sega released a 6-button controller of its own in 1993. Perhaps what the Genesis became known for the most in its latter years (for better or for worse) were its add-on units.

In addition to the Power Base Converter, which allowed the Genesis to play 8-bit Master System games, Sega followed in the footsteps of the TurboGrafx-16 and introduced its own CD-ROM add-on unit (Figure 6.12b) on December 12, 1991 in Japan and on October 15, 1992 in North America. Simply dubbed the **Sega CD**, the $299 optical disc unit provided hundreds of times the storage space of regular cartridges and could output CD quality sound. The add-on also contained the ability to scale and rotate graphics—something that could only be done on the standalone Genesis either artificially or with additional chips like the **Sega Virtua Processor (SVP)** chip in *Virtua Racing*.

Because it worked in tandem with the Genesis, Sega CD games were limited to the console's 64 on-screen color limitation. This made many of the **Full Motion Video (FMV)** style games that utilized live actors (such as *Sewer Shark* and *Night Trap*) appear washed out compared to the millions of colors displayed on standard television programs. While FMV games offered a new experience and were popular in the beginning, they quickly became nothing more than a fad from their lack of gameplay depth. Still, Sega sold more than 2 million Sega CD units.

■ CONSOLE COMPARISON: GENESIS VERSUS TURBOGRAFX-16

Comparing the first two fourth-generation consoles, "TurboGrafx clearly lagged behind Genesis in overall power, though it could display far more colors on the screen" (Kent, 2001, p. 412). It was the Genesis's 16-bit Motorola 68000 processor and Z80 co-processor (Table 6.5) that helped it excel over the TG-16. When comparing similar titles, Genesis games would often contain many more layers of **parallax scrolling** (separate background objects moving at different speeds), giving a greater sense of depth perception to the stages.

The systems were basically a draw when it came to cartridge storage capacity. "No HuCard was larger than 8 MegaBits, except for *Street Fighter [II]* which was 20. By comparison, the MegaDrive/Genesis version of the same game was 24 MegaBits" (NFG Games, 2015). Sound quality for both systems was often a matter of the developer's effort and/or mastery of the sound hardware for each machine. **Yuzo Koshiro** was a master video game music composer who produced many memorable

TABLE 6.5 Sega Mega Drive/Genesis Tech Specs

Manufacturer:	Sega
Launch Price:	$189.99
Release Date:	10/29/88 (JP), 8/14/89 (US), 11/30/90 (EU)
Format:	Cartridge
CPU:	16-Bit Motorola 68000 (7.67 MHz)
	Zilog Z80 co-processor (3.58 MHz)
Memory:	1 MB (8 Mbit) ROM/64 KB RAM
Resolution:	320 × 224 pixels
Colors:	64 from a palette of 512
Sound:	6 channel stereo

soundtracks for the Genesis, including *The Revenge of Shinobi* and *Streets of Rage* series among others. Responsible for the powerful score of *ActRaiser* on the Super Nintendo, Koshiro has been regarded as "arguably the greatest game-music composer of the 16-bit age" (Nintendo Power, 2006, p. 102).

HEAD-TO-HEAD

To distinguish the graphics and sound between Genesis and TurboGrafx-16, compare the following TG-16 games that were later ported to Genesis: *Cadash, Devil's Crush* (TG-16) to *Dragon's Fury* (Genesis) and *Aero Blasters* (TG-16) to *Air Buster* (Genesis).

■ KEY GENESIS TITLES

The key title to Sega's success with Genesis was *Sonic the Hedgehog* (seen in Figure 6.14), programmed by **Yuji Naka** (*Phantasy Star, Ghouls 'n Ghosts*). Developed directly for the U.S. market, Sonic's designer **Naoto Ohshima** explained, "his shoes were inspired by the cover to Michael Jackson's *Bad* [album], which contrasted heavily between white and red [which] went well for a character who can run really fast, when his legs are spinning" (Ohshima, 2009, p. 2). Sonic's bad attitude and blue color perfectly symbolized Sega's image at that time.

The game released in the United States on June 23, 1991—more than a month before Sonic's Japanese release and two months before Super Nintendo would reach U.S. shores. Sonic's graphics and sound were some of the best on the Genesis at that time. Naka and his team were able to squeeze sound and graphic quality out of the system like nothing seen before it. Controlling the hedgehog as he blazed across the screen, bounced off of springboards, and ran 360-degree loops was a refreshingly new experience for gamers.

Other defining titles could be found throughout each phase of the Genesis's history. *Phantasy Star II* was the sequel to the Master System classic and spawned two sequels on the Genesis. *Sonic the Hedgehog* also received two sequels on the system, as well as several spinoffs like *Sonic & Knuckles* and *Sonic the Hedgehog Spinball*.

Genesis was also a choice system for "beat'em up" games with its three *Streets of Rage* titles. Once Nintendo's third-party licensing limitations were lifted, the Genesis received some excellent games from Capcom and Konami such as *Street Fighter II': Special Champion Edition, Rocket Knight Adventures, Castlevania: Bloodlines*, and *Contra Hard Corps*. One of the most regarded action games on the system was Treasure's *Gunstar Heroes*, a platform shooter that had many special effects once thought impossible on the Genesis. Well over 700 games were released for the system, with most of its best titles landing on American store shelves.

FIGURE 6.14 Box art to five defining Genesis titles including: (a) *Phantasy Star II*, (b) *Sonic the Hedgehog*, (c) *Streets of Rage 2*, (d) *Shinobi III*, and (e) *Gunstar Heroes*.

(a) (b) (c) (d) (e)

HANDHELD SNAPSHOT: ATARI LYNX

FIGURE 6.15 Atari Lynx.

The **Atari Lynx** (Figure 6.15) launched on September 1, 1989 for $189.95—about a month after Nintendo's Game Boy. It was the first handheld system with a color, backlit LCD screen, sported 16-bit graphics, and could be flipped upside down to accommodate left or right-handed play. See Table 6.6. The Lynx had the ability to scale sprites, as the well as the capability of networking several units together for multiplayer action with **Comlynx** cables.

An updated "Lynx II" was released in July 1991, featuring better battery life, a sleeker design, and an improved headphones jack that added stereo sound. Approximately 72 games (see Figure 6.16 for top picks) were officially licensed and an estimated 3 million Lynx systems picks) were sold. Despite its successes, its popularity paled in comparison to the Nintendo Game Boy.

TABLE 6.6 Atari Lynx Tech Specs

Format:	Cartridge/6 AA batteries (4–6 hours)
CPU:	8-bit WDC 65SC02 (4 MHz); 2 × 16-bit CMOS (16 MHz)
Memory:	64 KB RAM
Resolution:	160 × 102 pixels/3.5" diagonal LCD screen
Colors:	16 from a palette of 4096 colors
Sound:	4 channel, 8 bits per channel, with 3.5 mm headphones jack

FIGURE 6.16 Box art to five defining Lynx titles: (a) *Blue Lightning*, (b) *S.T.U.N. Runner*, (c) *Chip's Challenge*, (d) *Todd's Adventure in Slime World*, and (e) *California Games*.

(a) (b) (c) (d) (e)

FIGURE 6.17 Nintendo Super Famicom console and 6-button controller.

■ SUPER FAMICOM

The Famicom remained a strong competitor to the PC Engine and the Mega Drive was not selling well in Japan. Similarly, the NES continued to perform well after the release of the Genesis and TurboGrafx-16 in the west. Nintendo had dominated the last generation by such a wide margin, they weren't in a real hurry to enter the 16-bit market compared to their competition. Nintendo finally launched the **Super Famicom (SFC)** (Figure 6.17) in Japan on November 21, 1990—more than *three years* after PC Engine and over *two years* after the Mega Drive launched. The system was created by Famicom designer **Masayuki Uemura**.

Its debut price was ¥25,000 yen (about $210) and like its predecessors, only two games were available on launch day—*F-Zero* and *Super Mario World*. According to Steve Kent (2001), "nearly 1.5 million people [in Japan] ordered the console" and "tens of thousands of people lined up in front of department and electronics stores the night before" its release—leading to all of Tokyo being slowed down in the process (p. 431). The Super Famicom quickly became the leading 16-bit system in Japan, followed by the NEC PC Engine in second, and Sega's Mega Drive in a distant third place.

■ SUPER NINTENDO

A year after its debut in Japan, Nintendo released the **Super Nintendo Entertainment System (SNES)** (Figure 6.18) in the United States on August 23, 1991 for $199. The system was redesigned by **Lance Barr**—the same designer who remodeled the NES for the U.S. market. Like the Super Famicom, its controller featured four main action buttons, two unique shoulder buttons, and was more ergonomic than the NES pad. The button colors were changed from green, blue, red, and yellow to shades of purple and Barr "changed the controller's X and Y buttons so they had a concave curvature, which offered a better haptic distinction between all four face

FIGURE 6.18 The Super Nintendo Entertainment System with a 6-button controller.

buttons" (Reeves, 2017, p. 95). The North American system came bundled with the classic hit *Super Mario World* and despite only a handful of launch titles (Table 6.7), more than 30 games were available by the end of December—including *ActRaiser, Final Fantasy II, Super Castlevania IV*, and *Super Ghouls 'n Ghosts.*

TABLE 6.7 Super Nintendo U.S. Launch Titles

- F-Zero (Figure 6.19a)
- Gradius III
- Pilotwings
- SimCity
- Super Mario World (Figure 6.19b)

Unlike the consumer loyalty it embraced in Japan, the video game market was a bit different in North America and many gamers had hopped on the Sega bandwagon. By the time the Super NES was released, the Sega Genesis was selling for $149 and had established itself as the next generation market leader in the United States (Sheff, 1993, pp. 353–356). Nintendo also had to compete with Sega's aggressive marketing campaign. Following the "Genesis does what Nintendon't" advertisements (Figure 6.20), Sega started a line of commercials that depicted Mario as a slow game for children, with *Sonic the Hedgehog* portrayed as the game that cool people (especially teens) should be playing.

When competition between the Super Nintendo and Sega Genesis heated up, the TurboGrafx-16 was out of the race and became a clearance item on most store shelves. In what became known as the most prominent **"console war,"** the rivalry between Sega and Nintendo reigned fierce during this time. Sega coined the term **"blast processing"** in their advertisements to emphasize the systems faster processing speed. The SNES became known for its **"Mode 7"** special effects that allowed for the **scaling** (zooming) and **rotation** of graphics. In short, the SNES contained many graphics modes, labeled zero through seven. The seventh mode [Mode 7] allowed for programmers to scale and rotate background graphics (Ritz, 2013). To complement its hardware strengths, Nintendo's new slogan became "Now You're Playing with Power—Super Power."

■ CONSOLE COMPARISON: SNES VERSUS GENESIS AND TURBOGRAFX-16

Mode 7 was one of the biggest features that set the SNES apart from Genesis and TurboGrafx-16. Its capabilities allowed for unique level design and shifting "camera angles" as immediately noticeable in games like *F-Zero* and *Pilotwings*. The effects were used in a multitude of ways (often coming across like developers experimenting with the technology) such as warping the title on the introductory screen of *ActRaiser*, rotating levels in *Super Castlevania IV*, and the 3D flying overview maps in *Secret of Mana*. The system was also capable of **mosaic** (scrambling blocks) effects and true **color layering** (where translucent sprites could be seen through and blend with background colors). Konami's *The Legend of the Mystical Ninja* (Figure 6.21) used all of these effects.

FIGURE 6.19 Screenshots from SNES launch titles (a) *F-Zero* and (b) *Super Mario World.*

(a)

(b)

FIGURE 6.20 Magazine advertisement for Super Nintendo in 1992.

Puts you in control.

The new SUPER NES CONTROL SET™ gives you the ultimate power of choice. We've given Mario a break by taking the Game Pak out of the package and lowered the price to put the control where it belongs -- with you! So the question arises: Which game will you buy first? How about the arcade sensation Street Fighter II? It's a knock out! Are you into art? Mario Paint (sold with the new Super NES Mouse) may be just the ticket. How about the new epic Legend of Zelda game? F-Zero? Final Fantasy II? Are your sights set on the amazing Super Scope 6? The choice is yours. And with a price tag of only $99.99* lookin' you in the face, how can you refuse? Exercise your power to choose. CHOOSE CONTROL!

Make your choice from over 125 Super NES games planned for release by the end of the year.

Nintendo®

* Suggested retail price.

FIGURE 6.21 Screenshots from Konami's *The Legend of the Mystical Ninja* showcasing the Super Nintendo's color layering and Mode 7 scaling and rotation effects.

Another feature that gave the Super Nintendo an edge over its competitors was its **S-SMP** audio processing unit (Table 6.8). The unit consisted of a **Sony SPC700** 8-bit processing core, a 16-bit **digital signal processor (DSP)**, 64 K of **static random-access memory (SRAM)** shared by the two chips, and a 64-byte boot ROM. The sound system operated almost entirely independent of the rest of the console and could produce much more realistic sound samples when compared to the Genesis or TurboGrafx-16.

Its highest resolution edged out the TG-16's 512 × 224, but like that console (perhaps to accommodate its slower processor), most SNES games ran at its lower **256 × 224** resolution. TG-16 led in on-screen color capacity with 482, compared to Super Nintendo's 256 and Genesis's 64; however, some SNES games (like *Donkey Kong Country*) were rumored to display thousands of on-screen colors using **scale line blending** tricks. A number of **enhancement chips** were produced for SNES software, such as the **SuperFX** chip, for rendering **3D polygon graphics** in games like *Star Fox* and *Stunt Race-FX*.

The one feature that Super Nintendo lacked was processing speed. Sega's Motorola 68000 clocked at 7.67 MHz, more than twice the speed of the SNES's Ricoh 5A22. However, it was Sega's **Yamaha VDP graphics chip** which provided quicker **Direct Memory Access (DMA)** transfer speeds and **VRAM bandwidth** that really made it faster. Many SNES titles (especially in the beginning) were plagued with **slowdown**, where the graphics and gameplay slowed down below regular speed. Slowdown did not affect a game's music but was nonetheless distracting. While *Sonic the Hedgehog* was blazing through levels on the Genesis, SNES games like *Gradius III* would slow down to a crawl when there were too many simultaneous objects moving on the screen.

TABLE 6.8 Super Famicom/SNES Tech Specs

Manufacturer:	Nintendo
Launch Price:	$199.99
Release Date:	11/21/90 (JP), 8/23/91 (US), spring 1992 (EU)
Format:	Cartridge
CPU:	16-bit Ricoh 5A22 processor (3.58 MHz)
Memory:	128 KB RAM
Resolution:	256 × 224 to 512 × 478 pixels
Colors:	256 (more with blending) from a palette of 32,768
Sound:	8-channel stereo S-SMP audio processing unit

HEAD-TO-HEAD

There were a vast number of games that were released on both the Super Nintendo and Sega Genesis. To compare the gameplay, graphics, and sound between them, see each system's version of *Aero the Acrobat, Earthworm Jim, Mortal Kombat II*, and *Thunder Force III* (Genesis) versus *Thunder Spirits* (SNES).

■ KEY SUPER NINTENDO TITLES

The Super Nintendo released a long line of defining titles over its lifespan. It became the console of choice for RPG fans with hits like *Final Fantasy II* and *III* (*IV* and *VI* in Japan) *Chrono Trigger, Secret of Mana*, and others. Nintendo's popular exclusives from the previous generation returned with enhanced sequels such as *Super Metroid, The Legend of Zelda: A Link to the Past* (shown in Figure 6.22), plus a late sequel to *Super Mario World* titled *Yoshi's Island.*

New franchises such as *Super Mario Kart* and *Star Fox* were also introduced on the SNES. And just when gamers thought they had seen everything the system had to offer, *Donkey Kong Country* emerged utilizing pre-rendered 3D graphics (i.e., advanced computer modeling) and other new techniques to produce one of the best-looking games on the console. *Donkey Kong Country* sold out of its initial shipment of 500,000 units in less than a week (Kent, 2001, p. 497) and spawned two SNES sequels. More than 700 games were released for the Super Nintendo in the United States, with approximately double the amount of titles on the Super Famicom in Japan.

■ NO CD-ROM?

Nintendo had originally planned on a CD-ROM add-on unit for the Super Nintendo, to be developed by **Sony Corporation**. By the time a **prototype** (sample model) had been developed by Sony, Nintendo began fearing business conflicts with the company—that giving Sony access to their technology could be a risk. "Nintendo executives allowed Sony to announce plans for the drive at the Consumer Electronics Show, then appeared the next day to say they had struck a deal with **Philips N.V.**" (Kent, 2001, p. 452). Neither add-on unit was ever released for the console, and the SNES would become the only fourth-generation competitor without a CD-ROM system.

DID YOU KNOW?

The Genesis outsold the SNES in the United States by almost two to one during the 1991 holiday season, making Sega the 16-bit console leader with a **55% market share** in January 1992 (Game Informer, 2002, p. 117).

FIGURE 6.22 Box art to five defining SNES titles including: (a) *Chrono Trigger*, (b) *Super Metroid*, (c) *Final Fantasy III*, (d) *The Legend of Zelda: A Link to the Past*, and (d) *Donkey Kong Country.*

(a) (b) (c)

(d) (e)

HANDHELD SNAPSHOT: SEGA GAME GEAR

FIGURE 6.23 Game Gear.

The **Game Gear** (Figure 6.23) was Sega's answer to Nintendo's Game Boy. It launched on October 6, 1990 in Japan and in the West on April 26, 1991 for $149.99. While less powerful than the Atari Lynx, Game Gear's backlit screen supported twice the number of on-screen colors. To expedite development of the handheld, Sega used much of the same technology from the 8-bit Master System (Wild, 2009, p. 161). See Table 6.9 for specs.

In addition to a **TV Tuner**, a **Master Gear Converter** allowed Master System games to be plugged into the Game Gear. Beyond its many Master System ports, Sega produced numerous spinoffs of its popular franchises on the system (Figure 6.24). More than 300 games were officially licensed and about 10 million Game Gears were sold globally.

TABLE 6.9 Game Gear Tech Specs

Format:	Cartridge/6 AA batteries (3–5 hours)
CPU:	8-bit Zilog Z80 processor (3.57 MHz)
Memory:	24 KB (8 KB RAM and 16 KB video RAM)
Resolution:	160 × 146 pixels/3.25" diagonal LCD screen
Colors:	32 from a palette of 4096
Sound:	4-channel mono speaker with 3.5 mm stereo jack

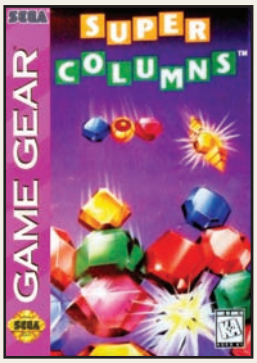
FIGURE 6.24 (a) *Sonic The Hedgehog: Triple Trouble*, (b) *Shinobi II: The Silent Fury*, (c) *Shining Force: The Sword of Hajya*, (d) *Ax Battler: A Legend of Golden Axe*, and (e) *Super Columns*.

(a)

(b)

(c)

(d)



(e)

FIGURE 6.25 Neo•Geo Advanced Entertainment System with its large joystick controller.

■ SNK NEO•GEO AES

One more fourth-generation console to reach the market was created by **Shin Nihon Kikaku** ("New Japan Project"), shortened to **SNK** Corporation in 1986. SNK was founded by Eikichi Kawasaki as a Japanese coin-op arcade developer in 1978. The company gained popularity from its arcade titles *Vanguard* (1981) and *Ikari Warriors* (1986), as well as its NES games *Baseball Stars* (1989) and *Crystalis* (1990).

SNK knew that one of the biggest chores for arcade operators was the practice of swapping out entire arcade cabinets every time old games were replaced with new titles. To alleviate this issue, the company developed the **Neo•Geo MVS (Multi Video System)** in 1990. The MVS was a single arcade cabinet that featured multiple, selectable titles (usually between two and four games), which could be easily changed by swapping internal cartridges and changing illustrations on the exterior of the cabinet. In addition to relieving arcade operators from replacing entire cabinets, having four titles in one cabinet saved floor space and proved to be quite profitable. That same year, SNK developed a home version of the MVS called the **Neo•Geo AES (Advanced Entertainment System)** (Figure 6.25).

The Neo•Geo AES kept its original name and released in the United States on June 18, 1991 for $649. It's "Gold System" came bundled with two joystick controllers and one game: *Baseball Stars Professional* or *NAM-1975*. What made the Neo•Geo unlike any console before it was that the AES was technologically *identical* to its MVS arcade counterpart, meaning its games were **exact copies** of the arcade games. Neo•Geo AES truly brought the arcade experience home. The system even featured a memory card slot that allowed console owners to save their progress on certain arcade games and continue them at home (or vice versa) if they owned the respective cartridge.

DID YOU KNOW?

"The Neo•Geo AES was originally only intended as a rental console for commercial establishments, but became popular enough among consumers to warrant a release as a home console" (Yang & Slaven, 2002, p. 338).

The AES released with a decent number of launch titles (Table 6.10), but the price tag held back the average consumer from even considering the system. Most Neo•Geo cartridges cost between **$199** and **$249** since they were both physically large and could hold **over 100 times more data** than other fourth-generation cartridges.

TABLE 6.10 Neo•Geo AES U.S. Launch Titles

- Alpha Mission II
- Baseball Stars Professional (Figure 6.26a)
- Cyber-Lip
- Ghost Pilots
- King of the Monsters
- League Bowling
- Magician Lord (Figure 6.26b)
- NAM-1975
- Ninja Combat
- Top Player's Golf

To help move the system, VP of marketing **Kent Russell** launched an aggressive marketing campaign that was often more controversial than Sega's. One memorable ad claimed, "YOU NEED A SET OF THESE" (with a picture of two steel balls) "TO PLAY ONE OF THESE" (with a picture of a Neo•Geo console). Another ad

FIGURE 6.26 Screenshots from AES launch titles (a) *Baseball Stars Professional* and (b) *Magician Lord.*

(a)

(b)

depicted a woman in lingerie with the caption "I Remember When He Couldn't Keep His Hands Off Me!" as her man appeared in the background deeply distracted by the Neo•Geo title *Cyber Lip*. The print advertisement in Figure 6.27 further illustrates this aggressive marketing campaign.

One game that shaped the future for Neo•Geo was Capcom's arcade hit *Street Fighter II: The World Warrior* (1991). *SFII* is credited for launching the fighting boom in the early 1990s, which revived the arcade scene for a while (June 2013). SNK jumped on the bandwagon and became one of the most prolific fighting game publishers, with titles like *Fatal Fury, Art of Fighting, Samurai Shodown, The King of Fighters*, and many more.

TABLE 6.11 Neo•Geo AES Tech Specs

Manufacturer:	SNK
Launch Price:	$649.99
Release Date:	4/26/90 (JP rental), 6/18/91 (U.S.), 7/01/91 (national)
Format:	Cartridge
CPU:	Motorola 68000 (12 MHz) and Zilog Z80 (4 MHz)
Memory:	64 KB main, 84 KB (total) video, 2 KB audio
Resolution:	304 × 224 pixels
Colors:	4096 from a palette of 65,536
Sound:	15 channel stereo

■ CONSOLE COMPARISON: NEO•GEO AES VERSUS THE REST

The **Neo•Geo AES** was in a league of its own from its high price tag and from being the most powerful console of the fourth generation. Some of the advertisements for the Neo•Geo marketed the console as 24-bit, although it was technically a 16-bit system powered by a 16-bit **Motorola 68000,** which ran parallel to an 8-bit **Zilog Z80** co-processor (Table 6.11). On paper, this is similar to the specs of the Sega Genesis; however, Neo-Geo's processor was much faster. The AES's 65,536 color palette and 4096 on-screen color capacity was leagues ahead of other fourth-gen systems. With more memory to work with and nearly double the number of sound channels, most Neo•Geo games looked and sounded far better than all other fourth-generation console games.

HEAD-TO-HEAD

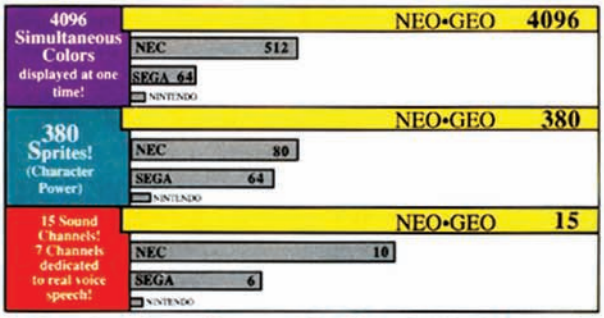
A great way to compare Neo•Geo games with Super NES and Genesis titles is to compare AES games that were ported to Nintendo and Sega's consoles. To compare the gameplay, graphics, and sound between them, check out all three systems' versions of *Fatal Fury, Fatal Fury II, Art of Fighting, 2020 Super Baseball*, and *Samurai Shodown*.

FIGURE 6.27 Magazine advertisement for Neo•Geo in 1991.

IF YOU'RE STILL PLAYING SEGA, NEC, OR NINTENDO YOU'RE NOTHING BUT A WEENIE!

IF YOU'RE PLAYING THE INCREDIBLY HIGH POWERED NEO•GEO® SYSTEM YOU'RE A REAL HOT DOG!

Tough talk, but think it over. Why fool around with limp, underpowered 16 bit systems when NEO•GEO® now offers the hottest, most advanced video entertainment system in the world!
Fact. NEO•GEO simply out-muscles those guys with the big names. NEO•GEO features a huge 330 meg hardware setup that delivers robust 15-channel real voice stereo sound. Unmatched graphics with over 65,000 vivid colors of amazing detail! Not to mention effects with 4-dimensional realism.
Does NEO•GEO cost more than other video game systems? You bet. Does a Ferrari cost more than a Yugo Does Prime Rib cost more than squirrel burgers? With NEO•GEO you get more than you paid for.
It's simple. Would you rather be a cold weenie? Or a real hot dog!



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• Premier Electronics Group (800) 783-7344

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All other product names are trademarks or registered trademarks of their respective holder.

The trademarks of "NEO-GEO" are registered by SNK Home Entertainment, Inc.

CIRCLE #114 ON READER SERVICE

FIGURE 6.28 Box art to five defining Neo•Geo titles including: (a) *Samurai Shodown*, (b) *Fatal Fury Special*, (c) *The Last Blade*, (d) *Metal Slug X*, and (e) *The King of Fighters '98*.

(a) (b) (c) (d) (e)

■ KEY NEO•GEO TITLES

Since the Neo•Geo AES library was based off its MVS arcade machine, most of the games were very **action oriented**. The console didn't really have any deep role-playing games and most titles could be finished in under an hour by a seasoned player. A large part of the AES library consisted of fighting/beat'em up games (Figure 6.28) like *Garou: Mark of the Wolves* and *Sengoku*, followed by shooter/shmup style games such as *Blazing Star* and *Metal Slug*. Beyond these types of games, the system had a handful of sports titles like *Baseball Stars Professional* and *Football Frenzy*, along with a few puzzle games like *Magical Drop*. Approximately 148 games were released for Neo•Geo, with most titles appearing on AES.

■ NEO•GEO CD

SNK eventually released a standalone, CD-based version of Neo•Geo called **Neo•Geo CD**. The system was created to play more affordable "CD versions" of its popular cartridges but also had a few exclusive titles. Neo•Geo CD games retailed for $49 to $79, compared to the $300 AES cartridges (GamePro, 1995, p. 30). The console released in Japan during September of 1994 and October of 1995 in the United States for $399. While it sold more than a half-million units, the system's **1X drive speed** suffered from extremely **slow load times** (where players would often have to wait 30–60 seconds for games to start up). SNK released an updated **2X version** of the unit in Japan called the **Neo•Geo CDZ**, but the system would quickly become overshadowed by the wave of fifth-generation consoles.

■ FOURTH-GENERATION MARKET SUMMARY

The PC Engine was quite successful in Japan, at one point becoming the country's top-selling video game console (Electronic Gaming Monthly, 1995, p. 15). However, it took a distant third place as the TurboGrafx-16 in the United States, lagging behind the Sega Genesis and Super Nintendo. The opposite was true of the Sega Mega Drive, which took third place in Japan, but did quite well in the United States. "Sega ultimately sold roughly 40 million Genesis consoles around the world, but less than a tenth of those were to Japanese customers. Meanwhile, the PC Engine moved merely 10 million units during its lifetime—but roughly eight million of those sales happened in Japan" (Parish, 2014).

Sega surpassed Nintendo with a **55% share** of the market in 1992 for a number of reasons. The Mega Drive and Genesis released two years before the Super Famicom and Super Nintendo. Its larger library of games (including *Sonic the Hedgehog*), lower price tag, and aggressive marketing campaign provided further leverage. To add to his legacy, Sega of America President Tom Kalinske is credited for pioneering the "**street date**" for video game releases with *Sonic the Hedgehog 2*. Called "Sonic Tuesday," Sega air shipped the game to all its retailers in the United States and Europe for a simultaneous, multi-national release day (Harris, 2014). That year, Nintendo released a stripped down "Super NES Control Set" for $99.99 (Figure 6.20), which removed *Super Mario World* and included only one controller.

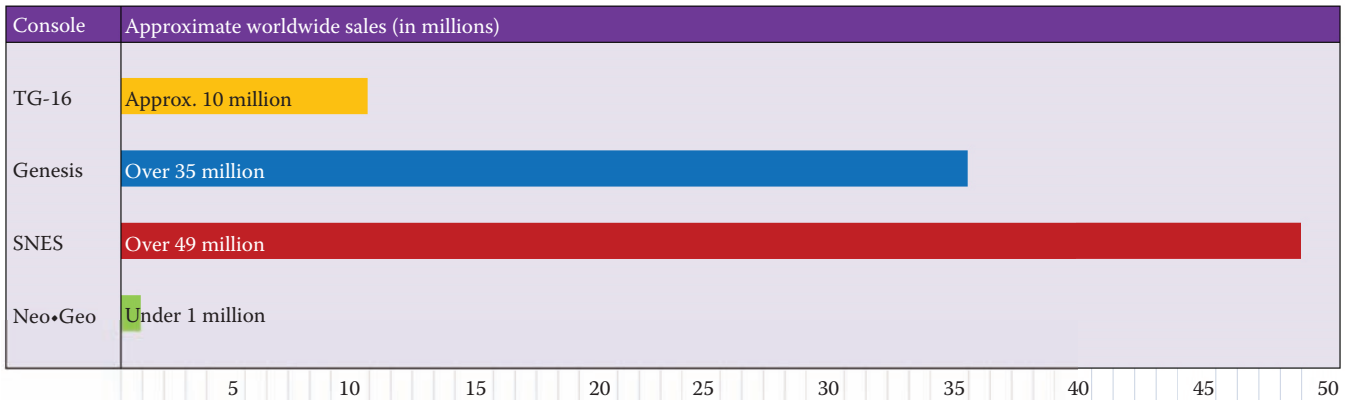
With Sega marketing the Genesis as the more mature system and the SNES as a child's toy, it did not help that

Nintendo also developed a reputation for **censoring** their early titles. In games like the U.S. version of beat'em up *Final Fight* (1991), Nintendo had Capcom replace blood with flashes and remove all references to alcohol. Among other changes, Capcom completely redrew the sprites of the sexy female characters to heavily-clothed, somewhat androgynous street punks. When *Mortal Kombat* (1993) released on both consoles, Nintendo's version replaced the blood with sweat and had several of the game's **fatalities** (finishing death moves) changed to less-violent depictions.

One turning point in the console war was when Nintendo secured the first home console port of the popular arcade hit *Street Fighter II*. The Genesis would not see a version of the game until well over a year later. Nintendo also eventually revoked its high level of censorship and the SNES version of *Mortal Kombat II* (1994) released with all the blood and fatalities intact. As the system matured and its library grew, the Super Nintendo would go on to outsell the Sega Genesis before the end of the fourth generation. The Genesis may have ultimately been outsold in the end because of Sega's focus on the next generation of 32-bit hardware, leaving the true winner of the 16-bit console war up for debate—at least in the United States. In the end, Sega sold close to 20 million Genesis units compared to approximately 23 million Super Nintendo systems in North America. Globally, the margin was even wider as shown in Figure 6.29.

Starting as a rental console for commercial establishments, the Neo•Geo AES was never planned to be a mass market console. SNK USA President **Ben Herman** claimed his goal for the system was a 10% market share; however, the console only reached a **2%** share (Herman, 2004). In the end, the Neo•Geo AES would never selL more than a million units and the fourth generation will most likely be remembered by the notable "console war" rivalry between Nintendo and Sega. Two lesser-known, multifunctional consoles from this generation included the **Philips CD-i** launched on December 3, 1991 and **Pioneer LaserActive**, which released on September 13, 1993.

FIGURE 6.29 Fourth-generation console sales graph.



■ FOURTH-GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the fourth generation of video games. Here is a list of the top 10 advancements that defined the generation:

1. 16-bit microprocessors
2. Expanded multi-button game controllers (between 3 and 8 buttons)
3. Parallax (multi-layer background) scrolling
4. True and pseudo-3D sprite scaling and rotation
5. Larger sprites (up to 64 × 64 [SNES] or 16 × 512 pixels [Neo•Geo])

6. More color (64 to 4096 on-screen colors from palettes of 512 to 65,536 colors)
7. Color layering
8. Flat-shaded 3D polygon graphics
9. CD-ROM add-ons for larger storage space and FMV (full motion video)
10. Stereo sound with digital audio playback and advanced music synthesis (FM synthesis and "wavetable" sample-based synthesis)

■ ACTIVITY: ARCADE TO HOME PORT COMPARISON II

To see how 16-bit home console ports became closer to the arcade games they were based on, play or screen gameplay from an arcade title and its home port for at least 30 minutes each. Take notes on the graphical, aural, and gameplay differences and similarities.

SUGGESTED TITLES

Compare the arcade version with its home console port of: the TurboGrafx-16 version of *Ninja Spirit, Raiden*, or *Splatterhouse;* the Sega Genesis version of *Altered Beast, Golden Axe*, or *OutRun;* and/or the Super Nintendo version of *Final Fight, Mortal Kombat*, or *Teenage Mutant Ninja Turtles IV–Turtles in Time*.

GUIDELINES

Always begin by playing/viewing the arcade version of the game; then discuss how the home port measures up. Then write a 500- to 1000-word comparison essay comparing the two games in regard to:

- Graphics – include size and scale, color palette, resolution (clarity), animation, effects, and presentation.
- Sound – include the quality and accuracy of the games' music and sound effects.
- Playability – include how well the games control and how fun they are to play.

QUESTIONS

1. How do these games compare to arcade ports from the previous generation?
2. Did the home console version add anything to or lack anything important from the arcade experience?
3. Do you feel that the console version was close enough to the arcade game that players would rather purchase the game and play from home?
4. Did the arcade version contain any features that would still attract gamers to an arcade venue to play the game?
5. What impact do you think this had on the arcade industry, if any?
6. Could the publisher/developer have done anything differently?
7. What are your final thoughts?

■ CHAPTER 6 QUIZ

1. Sega's motion-controlled, hydraulic cabinets by Director/Designer _____ led to games like *OutRun* (1986) and *After Burner* (1987):
   a. Yuji Naka
   b. Yu Suzuki
   c. Yuzo Koshiro
   d. Hayao Nakayama
2. The 1991 game that helped revive the arcade industry and popularized the fighting game genre:
   a. Street Fighter II: The World Warrior
   b. Mortal Kombat
   c. Virtua Fighter
   d. The King of Fighters

3. During its peak success in 1992, this game console gained a 55% share of the U.S. video game market:
   a. Super Nintendo
   b. Sega Genesis
   c. TurboGrafx-16
   d. Neo•Geo

4. Known as the TurboGrafx-16 in the United States, this system fared much better in Europe and Japan than in North America:
   a. Mega Drive
   b. PC Engine
   c. Super Famicom
   d. Neo•Geo

5. The PC Engine was known for being the *first* system to:
   a. have four controller ports built into the console
   b. offer a CD add-on unit to the console
   c. play perfect ports of arcade games in the home
   d. feature controllers with more than 2 buttons

6. This was the only fourth-generation system that came with large joysticks instead of traditional variants of the d-pad (+) controller:
   a. Neo•Geo
   b. Sega Genesis
   c. Super Nintendo
   d. TurboGrafx-16

7. Which of these peripherals was not developed for Sega Genesis?
   a. Power Base Converter
   b. SuperScope
   c. CD add-on
   d. 32X

8. Early on, _____ developed a reputation for censoring blood and sexuality from its games:
   a. TurboGrafx-16
   b. Super Nintendo
   c. Neo•Geo
   d. Sega Genesis

9. Neo-Geo was known for being the *first* system to:
   a. have four controller ports built into the console
   b. offer a CD add-on unit to the console
   c. play perfect ports of arcade games in the home
   d. feature controllers with more than 2 buttons

10. Which console was technologically superior based on tech spec numbers?
    a. Neo•Geo
    b. Super Nintendo
    c. Sega Genesis
    d. TurboGrafx-16

11. What video game is Yuji Naka famous for?
    a. Super Mario World
    b. Bonk's Adventure
    c. Sonic the Hedgehog
    d. All of the above

12. Which console sold the largest number of units by the end of the fourth generation?
    a. Super Nintendo Entertainment System
    b. Sega Genesis
    c. TurboGrafx-16
    d. Neo•Geo

13. Which console was *not* renamed or redesigned for the U.S. market?
    a. Neo-Geo
    b. Super Nintendo
    c. Sega Genesis
    d. TurboGrafx-16

14. SNK stands for:
    a. Shin Nihon Kikaku
    b. Shinto Nippon Kyoto
    c. Super Nintendo Kart
    d. System Network Keyframing

15. This fourth-generation console was built with only one controller port and was not considered a true 16-bit system:
    a. Neo•Geo
    b. Super Nintendo
    c. Sega Genesis
    d. TurboGrafx-16

16. This fourth-generation console was unique for its *Mode 7* scaling and rotation graphics effects and Sony sound chip:
    a. Neo•Geo
    b. Super Nintendo
    c. Sega Genesis
    d. TurboGrafx-16

True or False

17. With dimensions of 135 × 130 × 35 mm [or 5.3 × 5.1 × 1.37 inches], the Sega Mega Drive remains the smallest home console ever made.

18. *Altered Beast* was the original pack-in title for the Sega Genesis.

19. The CD-ROM² was the first CD-ROM add-on (expansion) unit for a video game console.

20. Nintendo coined the term "blast processing" in their advertisements to emphasize the Super Nintendo's faster processing speed.

■ FIGURES

FIGURE 6.1 Defining arcade fighting games in the fourth generation: (a) *Street Fighter II* (1991), (b) *Mortal Kombat* (1992), and (c) *Virtua Fighter* (1993). (*Street Fighter II* courtesy of Capcom, 1991; *Mortal Kombat* courtesy of Midway, 1992; and *Virtua Fighter* courtesy of Sega, 1993.)

FIGURE 6.2 NEC PC Engine and PI-PD001 controller. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18269320. Retrieved from https://en.wikipedia.org/wiki/TurboGrafx-16#/media/File:PC-Engine-Console-Set.jpg.)

FIGURE 6.3 NEC Turbo Grafx-16 console with TurboPad controller. (Courtesy Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17385690. Retrieved from https://en.wikipedia.org/wiki/TurboGrafx-16#/media/File:TurboGrafx16-Console-Set.jpg)

FIGURE 6.4 Screenshots from TurboGrafx-16 launch titles (a) *Keith Courage in Alpha Zones* and (b) *R-Type*. (*Keith Courage in Alpha Zones* courtesy of Hudson Soft/NEC, 1989; and *R-Type* courtesy of Irem/NEC, 1989.)

FIGURE 6.5 The NEC SuperGrafx (Japan), (a) TurboGrafx-CD add-on connected to a TurboGrafx-16 console (b), and the TurboDuo combo system (c). (Left: "The SuperGrafx" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18300104. Retrieved from https://en.wikipedia.org/wiki/PC_Engine_SuperGrafx#/media/File:SuperGrafx-Console-Set.jpg, Center: "NEC-TurboGrafx-16-CD-FL" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18874804. Retrieved from https://en.wikipedia.org/wiki/TurboGrafx-16#/media/File:NEC-TurboGrafx-16-CD-FL.jpg. Right: "NEC-TurboDuo-Console-wController-L" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34581517. Retrieved from https://en.wikipedia.org/wiki/TurboGrafx-16#/media/File:NEC-TurboDuo-Console-wController-L.jpg

FIGURE 6.6 Magazine advertisement for the TurboGrafx-16 in November 1992. (From "Too Little, Too Late?", VintageComputing.com April 21st, 2008 by Benj Edwards. Retrieved from http://www.vintagecomputing.com/wp-content/images/retroscan/tg16_three_large.jpg)

FIGURE 6.7 Box art to five defining TurboGrafx-16 titles including: (a) *Blazing Lazers*, (b) *Military Madness*, (c) *Splatterhouse*, (d) *Bonk's Adventure*, and *Neutopia*. (*Blazing Lazers* courtesy of Compile/NEC, 1989; *Military Madness* courtesy of Hudson Soft, 1989; *Splatterhouse* courtesy of Namco/NEC, 1990; *Bonk's Adventure* courtesy of Hudson Soft/NEC, 1990; and *Neutopia* courtesy of Hudson Soft/NEC, 1990.)

FIGURE 6.8 Nintendo Game Boy. (Courtesy of Evan-Amos. - Media:Game-Boy-FL.jpg, public domain. Available at https://commons.wikimedia.org/w/index.php? curid=37808150. Retrieved from https://en.wikipedia.org/wiki/Game_Boy#/media/ File:Game-Boy-FL.png)

FIGURE 6.9 Box art to five top Game Boy titles: (a) *Kirby's Dream Land*, (b) *Super Mario Land 2: 6 Golden Coins*, (c) *Tetris*, (d) *The Legend of Zelda: Link's Awakening*, and (e) *Pokémon Yellow*. (*Kirby's Dream Land* courtesy of HAL Laboratory/Nintendo, 1992; *Super Mario Land 2: 6 Golden Coins* courtesy of Nintendo, 1992; *Tetris* courtesy of Nintendo, 1989; *The Legend of Zelda: Link's Awakening* courtesy of Nintendo, 1993; and *Pokémon Yellow* courtesy of Game Freak/Nintendo, 1999.)

FIGURE 6.10 Sega Genesis and 3-button controller (U.S.), which was the first console to release outside of Japan with nearly identical casing to its Japanese sibling (Mega Drive). (Retrieved from http://ecx.images-amazon.com/images/I/512iSU24CdL._SL1280_.jpg)

FIGURE 6.11 Screenshots from Genesis launch titles (a) *Altered Beast* and (b) *Space Harrier* II. (Courtesy of Sega, 1989.)

FIGURE 6.12 Two of the many Genesis add-ons: (a) Power Base Converter and (b) Sega CD. ((a) "Sega-Genesis-Power-Base-Converter" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14230616. Retrieved from https://en.wikipedia.org/wiki/Sega_Genesis#/media/File:Sega-Genesis-Power-Base-Converter.jpg. (b) "Sega-CD-Model1-Set" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14400186. Retrieved from https://en.wikipedia.org/wiki/Sega_CD#/media/File:Sega-CD-Model1-Set.jpg)

FIGURE 6.13 Magazine advertisement for the Sega Genesis in 1990. (Posted on *The Requiem*, August 14, 2014. "The Genesis launches its ad campaign." Retrieved from http://www.seganerds.com/2014/08/14/the-genesis-launches-its-ad-campaign/)

FIGURE 6.14 Box art to five defining Genesis titles including: (a) *Phantasy Star II*, (b) *Sonic the Hedgehog*, (c) *Streets of Rage 2*, (d) *Shinobi III: Return of the Ninja Master*, and (e) *Gunstar Heroes*. (*Phantasy Star II* courtesy of Sega, 1990; *Sonic the Hedgehog* courtesy of Sonic Team/Sega, 1991; *Streets of Rage 2* courtesy of Sega, 1992; *Shinobi III: Return of the Ninja Master* courtesy of Megasoft/Sega, 1993; and *Gunstar Heroes* courtesy of Treasure/Sega, 1993.)

FIGURE 6.15 Atari Lynx. (Courtesy of Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=19709905. Retrieved from https://en.wikipedia.org/wiki/Atari_Lynx#/media/File:Atari-Lynx-I-Handheld.jpg)

FIGURE 6.16 Box art to five defining Lynx titles: (a) *Blue Lightning*, (b) *S.T.U.N. Runner*, (c) *Chip's Challenge*, (d) *Todd's Adventure in Slime World*, and (e) *California Games*. (*Blue Lightning* courtesy of Epyx/Atari, 1989; *S.T.U.N. Runner* courtesy of Atari Games, 1989; *Chip's Challenge* courtesy of Epyx/Atari, 1989; *Todd's Adventure in Slime World* courtesy of Epyx/Atari, 1992; and *California Games* courtesy of Epyx/Atari, 1989.)

FIGURE 6.17 Nintendo Super Famicom console and 6-button controller. (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17748368. Retrieved from https://en.wikipedia.org/wiki/Super_Nintendo_Entertainment_System#/media/File:Nintendo-Super-Famicom-Set-FL.jpg)

FIGURE 6.18 The Super Nintendo Entertainment System with a 6-button controller. Retrieved from https://en.wikipedia.org/wiki/Super_Nintendo_Entertainment_System#/media/File:SNES-Mod1-Console-Set.jpg

FIGURE 6.19 Screenshots from SNES launch titles (a) *F-Zero* and (b) *Super Mario World.* (Courtesy of Nintendo, 1991.)

FIGURE 6.20 Magazine advertisement for Super Nintendo in 1992. (Posted by Tanooki's Stuff on August 16, 2011. Retrieved from https://www.flickr.com/photos/65846913@N02/6052166222)

FIGURE 6.21 Screenshots from Konami's *The Legend of the Mystical Ninja* showcasing the Super Nintendo's color layering and Mode 7 scaling and rotation effects. (Courtesy of Konami, 1992.)

FIGURE 6.22 Box art to five defining SNES titles including: (a) *Chrono Trigger*, (b) *Super Metroid*, (c) *Final Fantasy III*, (d) *The Legend of Zelda: A Link to the Past*, and (d) *Donkey Kong Country*. (*Chrono Trigger* courtesy of SquareSoft, 1995; *Super Metroid* courtesy of Intelligent Systems/Nintendo, 1994; *Final Fantasy III* courtesy of SquareSoft, 1994; *The Legend of Zelda: A Link to the Past* courtesy of Nintendo, 1992; and *Donkey Kong Country* courtesy of Rare Ltd./Nintendo, 1994.)

FIGURE 6.23 Game Gear. ("A Sega Game Gear handheld video game system." by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=12172585. Retrieved from https://en.wikipedia.org/wiki/Game_Gear#/media/File:Game-Gear-Handheld.jpg)

FIGURE 6.24 (a) *Sonic The Hedgehog: Triple Trouble, (b) Shinobi II: The Silent Fury, (c) Shining Force: The Sword of Hajya, (d) Ax Battler: A Legend of Golden Axe*, and (e) *Super Columns*. (*Sonic The Hedgehog: Triple Trouble* courtesy of Aspect/Sega, 1994; *Shinobi II: The Silent Fury* courtesy of Sega, 1992; *Shining Force: The Sword of Hajya* courtesy of Sonic! Software Planning/Sega, 1994; *Ax Battler: A Legend of Golden Axe* courtesy of Aspect/Sega, 1991; and *Super Columns* courtesy of Sega, 1995.)

FIGURE 6.25 Neo•Geo Advanced Entertainment System with its large joystick controller. ("Neo-Geo-AES-Console-Set" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18260466. Retrieved from https://en.wikipedia.org/wiki/Neo_Geo_(system)#/media/File:Neo-Geo-AES-Console-Set.png)

FIGURE 6.26 Screenshots from AES launch titles (a) *Baseball Stars Professional* and (b) *Magician Lord.* (*Baseball Stars Professional* courtesy of SNK, 1991; and *Magician Lord* courtesy of ADK/SNK, 1991.)

FIGURE 6.27 Magazine advertisement for Neo•Geo in 1991. (Posted by Sebastian Mihai on January 2, 2016. Retrieved from http://sebastianmihai.com/downloads/ngscans/Neo-Geo-Hotdog.jpg)

FIGURE 6.28 Box art to five defining Neo•Geo titles including: (a) *Samurai Shodown*, (b) *Fatal Fury Special*, (c) *The Last Blade*, (d) *Metal Slug X*, and (e) *The King of Fighters '98*. (*Samurai Shodown* courtesy of SNK, 1993; *Fatal Fury Special* courtesy of SNK, 1993;

The Last Blade courtesy of SNK, 1998; *Metal Slug X* courtesy of SNK, 1999; and *The King of Fighters '98: The Slugfest* courtesy of SNK, 1998.)

FIGURE 6.29 Fourth-generation console sales graph. (Designed by Wardyga using data from Resource Site for Video Game Research, "Console Wars through the Generations". Available at http://dh101.humanities.ucla.edu/DH101Fall12Lab4/graph—console-wars and GamePro. "The 10 Worst-Selling Consoles of All Time." Retrieved from http://www.gamepro.com/gamepro/domestic/games/features/111822.shtml and Consoles +, issue 73.)

Pro File: Yu Suzuki: Photo by Yu Suzuki, Game Developers Conference 2011, Day 3 (2).jpg: Official GDCderivative work: Masem. This file was derived from: Yu Suzuki, Game Developers Conference 2011, Day 3 (2).jpg, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=14496549.

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Sex and Violence Take Center Stage

OBJECTIVES

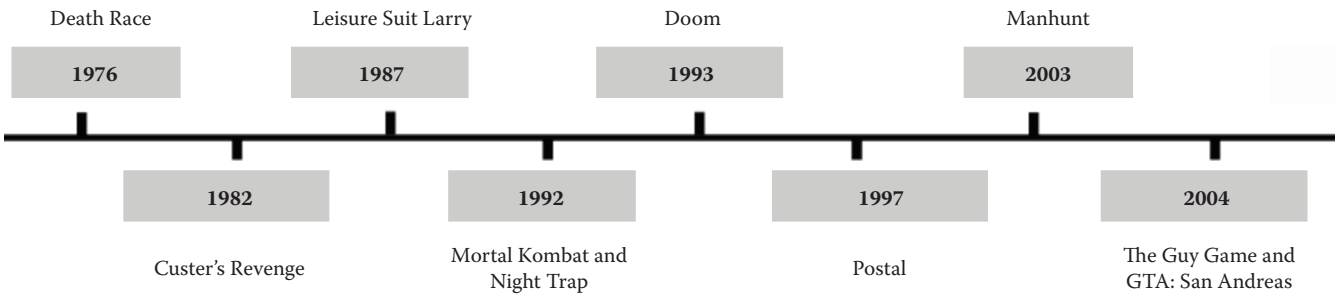
After reading this chapter, you should be able to:

- Present basic demographic data on who plays video games.
- Review the history of sex, nudity, and adult themes in video games.
- Discuss popular titles known for nudity and/or explicit sexual situations.
- Summarize public reactions to sexual situations and adult themes in gaming.
- Elaborate on gender, race, and LGBT portrayals in video games.
- List possible reasons for gender and race inequities in video games in the United States.
- Compare portrayals of sexuality and violence with Japanese and European markets.
- Review the history of violence, gore, and controversies in video games.
- Summarize major court hearings, bills, and outcomes from explicit games.
- Provide details on regulatory organizations such as the ESA (IDSA) and ESRB.
- Decipher the various icons and specific content descriptors of ESRB ratings.
- Be familiar with popular video game titles known for explicit violence and gore.
- Reflect on recent studies about the effects of video game content on society.

■ KEY TERMS AND PEOPLE

3DO Interactive Multiplayer
Action Replay
American Psychological Association
Joe Baca
Charles "Chuck" Benton
Birdo
Ed Boon
Sam Brownback
Brown V. Ent. Merchants Ass'n
Ca Law Ab 1793
California Bill Ab1179
John Carmack
Catharsis theory
Hillary Clinton
Columbine High School
CompUSA
Correlation
Custer's Revenge
Customizable character
Death Race
Whitney Decamp
Demographic data
Desensitization
Digitized graphics
Doom
Entertainment Software Association (ESA)
Entertainment Software Rating Board (ESRB)
Eroge Games
ESRB Ratings
Family Entertainment
Christopher Ferguson
Protection Act (FEPA)
Fatalities
Federal Trade Commission (FTC)
First-Person Shooter (FPS)
Full Motion Video/FMV
GameStop
Grand Theft Auto
Andrew Grizzard
Dave Grossman
Hack/mod/patch
Grand Theft Auto
Hacks/mods/patches
Hot Coffee
Hyper-masculine
id Software
Inequities
Interactive component
Interactive Digital Software Association
Henry Jenkins
Herb Kohl
Joseph Lieberman
Lesbian, Gay, Bisexual, Transgender (LGBT)
Al Lowe
Douglas Lowenstein
Leisure Suit Larry
Manhunt
Minigame
Mortal Kombat
Mystique
Night Trap
Non-playable character (NPC)
On-Line Systems/Sierra
Oversexualized
Phantasmagoria
Arthur Pober
Poison
Polygons
Postal
Prosocial motive
Protagonist
Rockstar Games
John Romero
Sandbox game
Arnold Schwarzenegger
Short term aggression
Softporn Adventure
Soldier of Fortune
Stereotypical
The Guy Game
Jack Thompson
John Tobias
Video compact disc
Vivid Interactive
Ronald M. Whyte
Roberta Williams
Wolfenstein 3D
Leland Yee

■ HIGHLIGHTED GAMES TIMELINE



■ INTRODUCTION

The early 1990s was the time period that video game graphics became more realistic—and along with many gamers, video games matured. Sexual themes and violence began to take center stage in certain games, attracting the attention of lawmakers, the media, parents, and other social institutions. This chapter reviews this history of sex and violence in video games, in addition to portrayals of gender and race. Major legislation and regulation as "games grew up" will also be covered, including subsequent controversy and media coverage, as well as theories and scientific research on the effects of video games on society.

■ WHO PLAYS VIDEO GAMES?

Video games have come a long way since the early days of 8-bit graphics and primitive sound. Once primarily seen as a kids' hobby, those children have grown up and video games are now enjoyed by people of all ages. According to a recent report by the **Entertainment Software Association (ESA)**, the age of the average video game player in the United States is **35 years old** (ESA, 2016, p. 3). The average age was 30 years old just three years prior, indicating that dedicated gamers continue to play well into their older years. When divided by age group, this figure breaks down into a relatively balanced 27% of gamers under 18 years old, 29% between 18 and 35 years old, 18% between 36 and 49 years old, and 26% ages 50 and over.

Another change in recent generations has to do with gender. While early generations of video games were primarily played by and marketed to males, females now represent more than 40% of the gaming population. Today, U.S. video gamers consist of approximately **59% male** and **41% female**. As a matter of fact, "women age 18 or older represent a significantly greater portion of the game-playing population (31%) than boys age 18 or younger (17%) (ESA, 2016, p. 3). These gender percentages are similar to **demographic data** in other countries as well. These are important figures for the industry to take note of, as the market and types of games that cater to this audience must evolve with it for video games to remain relevant.

DID YOU KNOW?

About half of all female game players are over 35 years old and the most frequent female gamer is an average of 44 years old (ESA, 2016, p. 3).

■ SEX AND SOFTPORN ADVENTURE

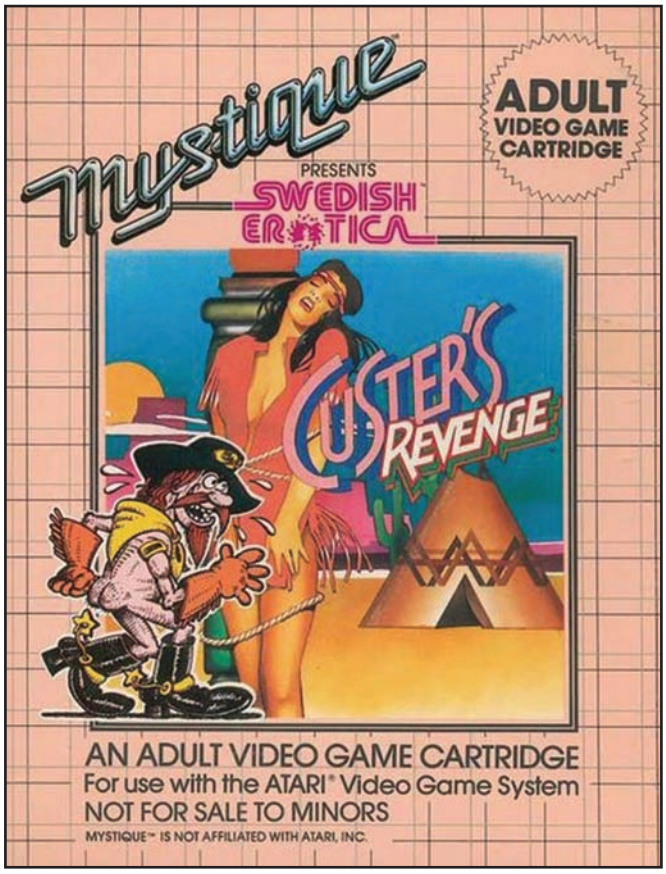
Sex, nudity, and adult themes in video games have always been more common in Eastern, Asian markets when compared to the United States—however, North America has matured since the early years of gaming. Sexual themes in video games became more popular in the United States when CD-ROM technology emerged in the 1990s. With improved graphics, live actors, and **full motion video (FMV)** capability, it was inevitable that more adult themes would begin infiltrating the gaming landscape. Prior to CD-ROM games, sexuality in games was kept at a minimum—particularly on the home console market. With a larger adult user base, the PC market was exposed to adult themes in video games much earlier.

One of the first titles known for strong sexual content was ***Softporn Adventure*** in 1981 by **On-Line Systems**. Developed by **Charles "Chuck" Benton** and released for PC, this text-only adventure starts off in a sleazy bar with the objective to win the affections of three women. Players enter numerous actions and collect items (such as a condom at a drugstore) in attempt to get eventually lucky. The game was soon featured in a *Time* magazine article by Kenneth M. Pierce on October 5, 1981 (Maher, 2012). One of the title's biggest criticisms was that there was no female protagonist version of the game.

■ CUSTER'S REVENGE

One of the first graphically explicit games released in the United States was ***Custer's Revenge*** (1982) by **Mystique** (Figure 7.1). Developed for the Atari 2600, its graphics were primitive, but the game was no less controversial. The player assumed the role of a naked General George Armstrong Custer (a historical figure known for his defeat at the Battle of Little Bighorn). The object of the game is "to navigate a battlefield to have sex with an Indian maiden who was tied to a post. Although

FIGURE 7.1 Box art to *Custer's Revenge* (1982).



Mystique claimed the sex was just a consensual bondage escapade and not rape, Native American groups as well as the National Organization for Women believed the game promoted sexual violence and staged national protests against it" (Gamespy, 2011, p. 1). Mystique went on to develop two other adult 2600 titles including *Beat 'Em & Eat 'Em* and *Bachelor Party*.

■ LEISURE SUIT LARRY

During the early 1980s, most of the adult games featuring sexual content were only released in Japan. Companies such as Koei, Enix, Square, and Nihon Falcom "helped create the early demand for what are now known as **'eroge'** games, or Japanese erotic games (Ellison, 2014, para. 14). The U.S. PC market had a handful of adult card games such as *Samantha Fox Strip Poker* by **Martech** in 1986. That same year, On-line Systems approached designer **Al Lowe** to develop an adult graphical adventure game similar to their popular *King's Quest* series. The result was an expanded, visual version of *Softporn Adventure*, released in 1987 as ***Leisure Suit Larry in the Land of the Lounge Lizards*** (Figure 7.2).

The game follows a similar story of a 38-year-old virgin named Larry Laffer who is on a quest to get lucky in the fictional city of Lost Wages. Larry encounters four main women along the way, who he'll try to win over by purchasing gifts that can be bought from money won at a casino. The game was not initially advertised by Sierra, but word-of-mouth led to it becoming a sleeper hit, selling an estimated 250,000 copies.

While some retailers refused to carry the game, reception of the title was favorable. Perhaps because it wasn't overly graphic (sex scenes were covered with a "censored" bar), the game did not lead to any major public controversies. In fact, it spawned a number of sequels and remakes on various platforms—including a home console version called *Leisure Suit Larry: Magna Cum Laude* in 2004. In 2012, *Time* magazine listed it as one of the 100 greatest video games of all time, calling it "a humor-filled adventure game that wasn't bashful

FIGURE 7.2 Screenshots and box art to the Amiga version of *Leisure Suit Larry in the Land of the Lounge Lizards* (1987).

about showing some skin [and that] the world hadn't seen anything like it" (Aamoth, 2012, p. 34).

■ NIGHT TRAP AND FMV GAMES

CD-ROM games allowed for more memory, which meant the ability for full motion video (FMV), more animation, and in many cases, more realistic graphics. One of the first CD games to garner public attention in the United States was ***Night Trap*** (1992) developed by **Digital Pictures** for Sega CD (Figure 7.3). The game plays like an interactive B-movie about a group of females having a slumber party who are under attack by vampire-like beings called "Augers." The player is charged with monitoring a video surveillance system and activating traps at the right moment to catch the Augers before they attack the women.

While the game did not contain any nudity or sex scenes, its mature content was enough to catch the attention of Congressional leaders. In the eyes of certain politicians, "*Night Trap* was believed to be a simulator for would-be stalkers, murderers and rapists. This stemmed from the misconception that the object was to trap and kill the girls—the exact opposite of what [the player] actually did" (Robertson, 2013, para. 10). This perception of the game led it to being removed from store shelves at Toys "R" Us and Kay•Bee Toys just two weeks before Christmas of 1993 (GamePro, 1994, p. 184). The game's spotlight in the media may have actually helped the title, as *Night Trap* was ported with better graphics to the Sega 32X, 3DO, MS-DOS, and Macintosh the following year.

Another controversial title on CD-ROM was **Roberta Williams'** ***Phantasmagoria*** (1995) by **Sierra On-Line** (formerly Online Systems). Like *Night Trap*, it contained live action footage but was more explicit in its sexual and violent content—which included a rape scene. As a PC-only title in the United States, the game received less public attention—however, **CompUSA** (the largest U.S. PC retailer at the time) refused to stock the game.

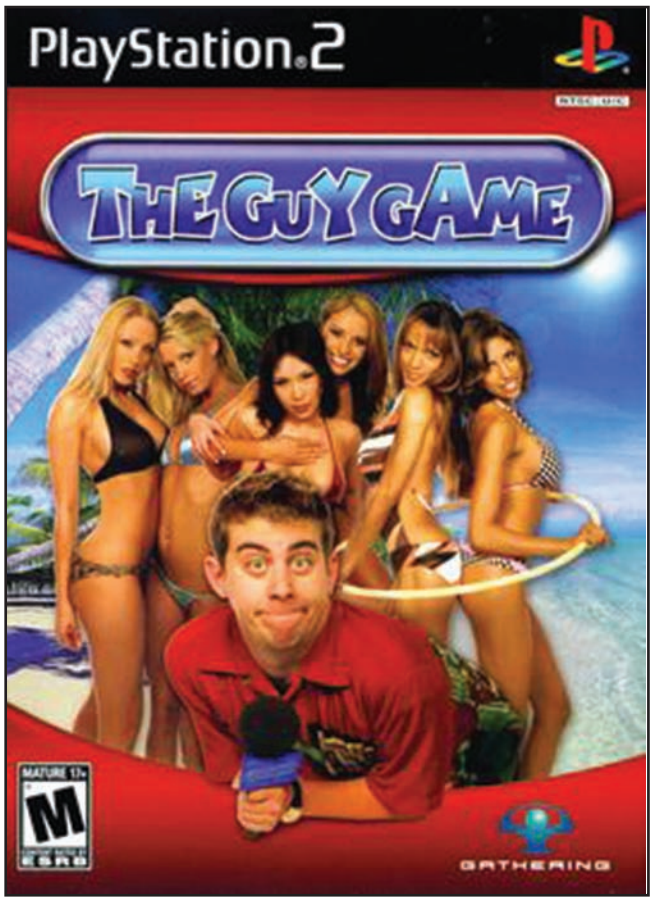
Electronic Arts founder Trip Hawkins's **3DO Interactive Multiplayer** released a year after *Night Trap* on October 4, 1993. By the following year, adult entertainment company **Vivid Interactive** began publishing "Adult Only" **video compact discs (VCDs)** for the system. These were not games, but rather edited adult films compressed into MPEG-1 video data similar to the resolution of VHS. While less explicit than the films they were adapted from, the presence of such adult content on a home video game console was a new concept and may have helped push mature video games forward.

■ THE GUY GAME

One of the last FMV games to cause a stir was ***The Guy Game***, developed for PC, PS2 (Figure 7.4), and Xbox by **Topheavy Studios** and published by **Gathering** in 2004. The game plays like a trivia game show on spring break, where every question is followed by live-action video footage of host **Matt Sadler** giving the same question to young women in bikinis. If the women get the question wrong, they have to flash their breasts. Initially these scenes are censored, but successfully guessing the girls' answers eventually leads to full frontal nudity. The game's

FIGURE 7.3 Screenshots and box art to the original Sega CD version of *Night Trap* (1992).

FIGURE 7.4 Box art to the PS2 version of *The Guy Game*.



biggest controversy, however, came from a lawsuit from one of the contestants—claiming she was not informed the footage would be used for a video game and that she was only 17 years old when the footage was recorded (Topheavy Studios, Inc. v. Jane Doe, 2005, pp. 2–3).

Full motion video may have advanced sexual and mature themes in video games—however, as Eurogamer's Dave McCarthy (2007) pointed out:

"It was the introduction of **polygons** [3D graphics] that really enhanced the possibilities for depicting sexy videogame characters, and since the dawn of the PlayStation era, the industry has been peppered with them. *Duke Nukem* achieved a certain amount of infamy thanks to its scantily clad strippers and hookers; *Fear Effect*'s promotion push made no bones about its lesbian protagonists; and the *Dead or Alive* series, and its adjustable boob bounce, took its titillatory tendencies to their logical conclusion with the [*Dead or Alive Xtreme*] *Beach Volleyball* series (p. 2). See Table 7.1 for some other popular video games known for nudity and sexuality."

■ GRAND THEFT AUTO AND MODS

One of the most notorious polygonal games to bring sex and violence in gaming to the mainstream audience was the ***Grand Theft Auto*** series—especially when Rockstar Games transformed the series from a top-down perspective, to a more realistic, third-person **"sandbox"** [open world] game with *Grand Theft Auto III* in 2001. *GTA III* became instantly controversial by placing the player in the role of a criminal—introducing the ability to pay prostitutes for "services" to recover the player's health, in addition to killing civilians, police officers, and military personnel where players become "Wanted."

Grand Theft Auto: Vice City (2002) received criticism for ethnic discrimination, where a scenario in the game pits the player in a gang war between gangs referred to as the "Haitians" and "Cubans." It was *Grand Theft Auto: San Andreas* (2004) that drew global attention when a group of professional coders modified the game to unveil a disabled, partially complete, interactive sex **minigame** that was embedded in the game's code. The minigame could be accessed by altering the game's code or by using a third-party device such as the **Action Replay**. Triggered by accepting a female character's invitation for coffee—the mod became known as **"Hot Coffee"** (Figure 7.5).

When news of the minigame broke, the ESRB retroactively rerated the game with an **AO (Adults Only)** sticker until an updated version (which removed the minigame) was released. Despite the ESRB's confirmation that no violation had occurred, this led to a class action lawsuit

TABLE 7.1 FiveVideo Game Series Known for Nudity and/or Explicit Sexuality

Series	Debuted	Developer	Publisher(s)
Dead or Alive	1996	Team Ninja	Tecmo
God of War	2005	Sony Computer Entertainment Santa Monica Studio	Sony Computer Entertainment
Grand Theft Auto	1997	Rockstar Games	Rockstar Games
Mass Effect	2007	BioWare	Microsoft/Electronic Arts
The Witcher	2007	CD Projekt RED	CD Projekt and Atari

FIGURE 7.5 Screenshots before a Hot Coffee minigame in *Grand Theft Auto: San Andreas.*

against distributor **Take-Two**. Under the terms of the settlement, Take-Two provided a replacement disc with the sex scenes removed or a $5 to $35 refund to qualifying consumers (Hatfield, 2007, p. 1). Only $27,000 in settlements was claimed, compared to more than $1 million in attorney fees absorbed by Take-Two.

Modifications to a game's code like in the *Grand Theft Auto: San Andreas* Hot Coffee minigame are known as **"mods."** Mods were first made popular in the PC world and can come in the form of a **patch** (code from the developer to fix or add content to a game)—to a **hack** (unauthorized and/or illegal code by a skilled programmer which can alter certain graphics or other features of a game). **Art mods** alter a game's graphics and have been used to add sexual themes to games, such as nude or sexier **skins** (texture maps) to characters like Laura Croft from *Tomb Raider*. These types of skin mod hacks have become a common part of gaming culture and eventually turn up in just about every major PC release today.

■ GENDER AND RACE

Early video games have been typically presented through the Caucasian, male perspective, with the majority of game protagonists being white, male characters. Female characters have been commonly depicted as damsels in distress (*Super Mario Bros., Zelda*), **oversexualized** (early *Tomb Raider* games, *Dead or Alive* series), or as sex objects (*Grand Theft Auto, Duke Nukem*). A 1998 study by **Tracy Dietz** found the portrayal of female characters in video games to be "overwhelmingly **stereotypical**" and that "females portrayed in these games, even when they occupy the role of a hero, are often depicted as subordinate to male characters or are presented in terms of their sexuality" (p. 438).

While female game characters have often been oversexualized, male characters have commonly been portrayed as **"hyper-masculine"** (Figure 7.6). A hypermasculine character is one who "has an extremely imposing physical body; someone who is very muscular; someone who is certainly very aggressive. An effect of this hypermasculine characterization can also be to link being male with being violent" (Scharrer, 2000). While many modern games are making efforts to avoid these clichés, hypermasculine characters are still common in game series such as *Gears of War* and *God of War*, along with fighting games such as *Street Fighter* and *Mortal Kombat.*

The **lesbian, gay, bisexual, transgender** (**LGBT**) community has been commonly underrepresented in video games. Early games hinted at LGBT themes such as the **Birdo** character from the U.S. version of *Super Mario Bros. 2* (1988) on the NES. In the first-edition manual for the game, Birdo is referred to as a "male who believes that he is a female" who would rather be called "Birdetta" (Loguidice, 2009, p. 280). Capcom's Final Fight (1989) featured a character named **Poison** who was rumored to be a trans woman. LGBT characters have continued to appear in games ever since, but have usually been limited to **non-playable characters (NPCs)**.

Characters of color have also been presented in stereotypical or subordinate roles over generations of video games. A 2009 survey by **Williams, Martins, Consalvo, and Ivory** found that in more than 150 games across nine platforms, "white characters account for 84.95

FIGURE 7.6 Images of an oversexualized woman (Ivy from *Soul Calibur IV*) (a) and a hyper-masculine man (Marcus from *Gears of War*) (b).

(a)

(b)

percent of all primary characters, black 9.67 percent, biracial 3.69 percent and Asian 1.69 percent. Hispanics and Native Americans did not appear as a primary character in any game, they existed solely as secondary characters" (p. 825).

Modern games have done a better job with ethnic diversity, avoiding hyper-masculine stereotypes, and depicting female characters in a less sexualized manner. Blockbuster titles such as *Grand Theft Auto: San Andreas* and *GTA V, Prototype 2*, and *The Walking Dead* feature black characters as lead **protagonists**. Games like *Shadows of the Damned, Guacamelee*, and the *Just Cause* series feature Hispanic lead characters. Female characters such as Laura Croft have been redesigned to be less sexualized and more realistic-looking. Gay and lesbian characters are seeing more prominent roles in games, such as in *Borderlands: The Pre-Sequel!* and the *GTA IV* expansion, *The Ballad of Gay Tony*. Games that allow the player to **customize** their character's appearance, gender and ethnicity have added to this diversity—and many of those games (such as *Fable, Mass Effect* [Figure 7.7], and *Dragon Age*) allow the player to engage in same-sex relationships with other characters.

While improvements have been made to include a more diverse ethnic pool of characters and protagonists in video games, there continues to be a lean toward the Caucasian, male perspective. A 2013 study by **Stein, Mitgush, and Consalvo** revealed that "sports video games are one of the few places that racial minorities are present as primary characters, in contrast with most other genres of video games" (pp. 346–347). More male video game protagonists are avoiding the hyper-masculine stereotype, but white male characters continue to be the usual heroes—and female game characters still commonly find themselves in at least one sexual situation before the end of the game.

FIGURE 7.7 Games like *Mass Effect* allow players to fully customize their characters.

Possible reasons of gender and race **inequities** in the United States include consumer demand, the idea that games are mere reflections of real inequalities in society, and the fact that most game developers are white males. In a game developer survey by **Adam Gourdin** (2005), 88.5 percent of game respondents identified as male and only 11.5 percent of respondents identified as female (p. 11). Of the respondents, 92 percent of the game developers identified their sexual orientation as heterosexual (p. 15). Data from Williams, Martins, Consalvo, and Ivory (2009) suggests that "ethnically, [developers] are 83.3 percent white, 7.5 percent Asian, 2.5 percent Hispanic and 2.0 percent black" (p. 830). Creating characters and scenarios outside of their own paradigms adds an additional layer of research and effort for developers, who are already on tight deadlines.

While the oversexualization of female heroines may have declined in the United States (see Figure 7.8), these over-exaggerations continue to be prevalent in Japanese-developed games such as in *Dragon's Crown*, the *Dead or Alive* and *Soul Calibur* series, among others. An ongoing effort has been made to tone this content down in the United States, with game graphics (or at least the box art) being modified before the titles appear on North American retail shelves as seen in Figures 7.9 and 7.15.

■ VIOLENCE AND DEATH RACE

Partly due to their primitive graphics and sound, most early video games did not create a lot of controversy for their violence. In 1984, **J. R. Dominick** reported that "videogame violence is abstract and generally consists of blasting spaceships or stylized aliens into smithereens. Rarely does it involve one human being doing violence to another" (p. 138). One early arcade game that did attract the attention of the media was ***Death Race*** (1976) by **Exidy** (Figure 7.10). Inspired by the 1975 cult film *Death Race 2000*, the object of game is to run over stick figure beings called "gremlins" using a steering wheel and acceleration pedal.

Viewed from an aerial perspective, the gremlins look very similar to humans and this got the attention of national news programs such as *60 Minutes*. Only around 500 units were manufactured before the game was banned and pulled from the arcades (Gonzales, 2007, para. 11). Game violence was not a hot topic after this for about a decade, until Exidy released its next violent arcade game ***Chiller*** in 1986. *Chiller* was a light gun game that included two levels of shooting and mutilating characters bound in torture chambers.

■ MORTAL KOMBAT

Midway Games released ***Mortal Kombat*** (Figure 7.11) to the arcades on October 7, 1992—exactly one week before *Night Trap* hit store shelves. Produced to compete with Capcom's popular *Street Fighter II* fighting game, developers **Ed Boon** and **John Tobias** chose to use **digitized graphics** of real actors to help their game stand out from

FIGURE 7.8 The average sexualization of female characters by year of release shows an overall decline in recent years (Lynch et al., 2016, p. 574).

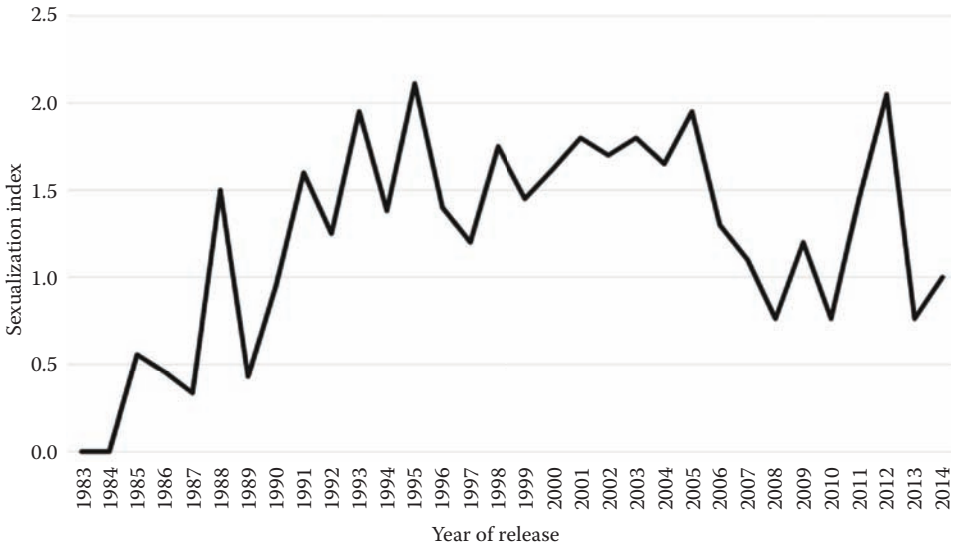
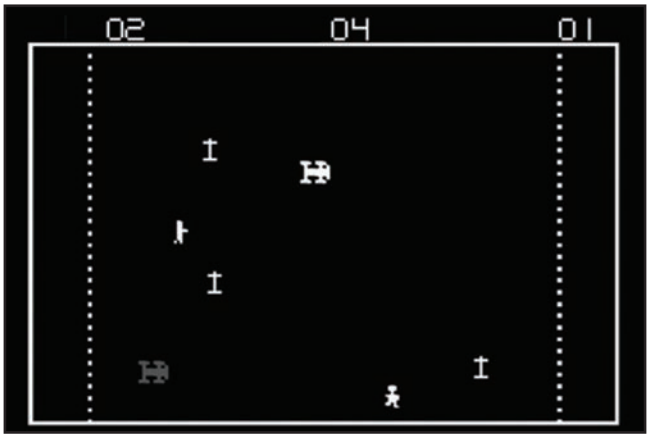


FIGURE 7.9 Censored for sexuality: Japanese game covers (a) versus U.S. game covers (b) for *Dead or Alive: Dimensions* (2011), *Shadows of the Damned* (2011), and *Nitroplus Blasterz: Heroines Infinite Duel* (2015).

(a) (b)

FIGURE 7.10 Screenshot of *Death Race*.



the crowd. They initially approached famous martial arts actors Steven Segal and Jean Claude van Damme to appear in the game; however, each of them were busy with other projects (Kent, 2001, p. 462). Without a famous name attached to the game, Boon and Tobias turned to excessive violence to capture the attention of gamers.

Blood was programmed to fly from most hits to a character's face—and being hit with an uppercut and certain special moves results in ridiculous amounts of blood spurting from the character and hitting the pavement. Even more violent than the battle rounds are the game's unique finishing moves called **"fatalities."** With the correct button combination and distance to the losing character, the winner of each match has a brief amount of time to assassinate his or her opponent. Like much of the game's blood, these fatalities aren't very realistic, but are extremely violent. For example, the fatality for character Sub-Zero sees him tear his opponent's head off with one punch, surgically ripping out the opponent's still-attached spine in the process.

FIGURE 7.11 Screenshots depicting the violence and gore from *Mortal Kombat* (1992).

TABLE 7.2 Modern ESRB Video Game Ratings and Their Meanings

Icon	Stands For	Description
RP	Rating Pending	Game has not been assigned a final rating by the ESRB
EC	Early Childhood	Suitable for children ages three and older
E	Everyone	Originally known as Kids to Adults(K-A); for all ages
E10+	Everyone 10+	Suitable for everyone 10 years of age and older
T	Teen	Generally suitable for those aged 13 years and older
M	Mature	Ages 17+ for violence, blood/gore, sexual content, or language
AO	Adults Only	18+ for stronger sexual content, nudity, violence, language, etc.

It wasn't long before *Mortal Kombat*'s violence and *Night Trap*'s mature themes caught the attention of Senator **Joseph Lieberman** (Democrat, CT). Lieberman, along with Senator **Herb Kohl** (Democrat, WI), held a number of hearings with video game companies (particularly Nintendo and Sega) on the marketing of such video games.

DID YOU KNOW?

When *Mortal Kombat* released on home consoles (Sega Genesis and Super Nintendo), Nintendo insisted that publisher **Acclaim** release a less-violent version for the SNES. As such, developer **Sculptured Software** made numerous modifications to the game—changing the blood to sweat, and altering most of the fatalities.

■ REGULATION AND THE ESRB

The hearings led by Lieberman and Kohl resulted in the formation of two organizations in 1994. First, the **Interactive Digital Software Association (IDSA)** was formed to represent the video game industry in areas such as "a global content protection program, business and consumer research, government relations and intellectual property protection efforts" (ESA, 2015). **Douglas Lowenstein** was elected as the founding president and the IDSA became the Entertainment Software Association (ESA) in 2003.

The second group to be formed was the **Entertainment Software Rating Board (ESRB)** with Dr. **Arthur Pober**. The ESRB became the industry standard for enforcing video game ratings, advertising guidelines, and privacy principles. Although Sega had developed and offered a ratings system of its own years prior, the industry settled on the ESRB as the industry's self-regulatory body for interactive software. See Table 7.2 for ratings and descriptions.

To streamline the rating process, publishers submit a detailed questionnaire and footage of the game's most graphic and mature content, in addition to its proposed packaging. Everything from its context, storyline, reward system, unlockable content, and other elements are factored into the game's final rating. The ratings then are developed to include an icon on the front of the game's box art (depicting the suggested age group), followed by more detailed information on the backside of the packaging (see Figure 7.12 for examples).

■ DOOM AND FPS GAMES

About a year before the ESRB rating system was completed, another controversial game emerged on the PC landscape with **id Software**'s ***Doom*** (Figure 7.13) in December of 1993. Doom was primarily the product of programmers **John Carmack** and **John Romero**—who quickly became rock stars of the computer gaming community. It was the company's second major **first-person shooter (FPS)**, following ***Wolfenstein 3D*** (1992) which was played through the eyes of a commando shooting Nazi soldiers. *Doom* was even bloodier, with gore galore from blasting demons in satanic environments.

Unlike *Night Trap* and *Mortal Kombat*, *Doom* didn't receive much attention from lawmakers until years later, when a number of school shootings began to arise starting in 1997. The incident that put *Doom* in the spotlight was the massacre at **Columbine High School** in Littleton, Colorado on April 20, 1999. After smuggling weapons into the school, 18-year-old **Eric Harris** and 17-year-old **Dylan Klebold** went on to kill 12 students

FIGURE 7.12 Some backside ESRB rating labels with icon and specific content descriptors.

and a teacher, injuring 23 others. The investigation on the boys revealed that they were obsessed with *Doom* and they often referenced the game when planning their massacre (Kent, 2001, p. 545).

This led to congressional hearings led by Senator **Sam Brownback** (Republican, KS) as early as May 4, 1999. Much of the discussion was based on the interactive component of violent video games versus the more passive consumption of other violent media. Particularly harsh on the video game industry was retired Lieutenant Colonel **Dave Grossman**, psychology and military science professor (West Point and Arkansas State University). Grossman claimed that *Doom* has been used by the military as a training simulator and that the home version was no different in training kids to kill. He often referred to the game a "mass murder simulator" (Chalmers, 2009, p. 75).

Representing the video games industry was Interactive Digital Software Association president Douglas Lowenstein. Lowenstein presented IDSA data which showed that "70 percent of people playing PC games and 60 percent of people playing video games were over 18 years of age" (Kent, 2001, p. 553). He also referenced ESRB data showing that the majority of published video games were not extremely violent and that there was a lack of research linking violent video games to violent behavior. Director of the Comparative Media Studies program at the Massachusetts Institute of Technology Dr. **Henry Jenkins** supported the gaming industry, claiming that "abolishing violent video games doesn't get us anywhere. These are the symbols of youth alienation and rage—not the causes" (Jenkins, 1999).

Another first-person shooter used as an example on multiple occasions during the hearings was ***Postal***, developed by **Running With Scissors** and published by **Ripcord Games** in 1997. The game's title was derived from the slang term "going postal" which became a phrase following a string of incidents between 1986 and 1997 where United States Postal Service (USPS) workers engaged in acts of mass murder against their superiors and others. While extremely violent, *Postal* was a poorly reviewed title that did not have strong sales—and Lowenstein pointed this out in his discussion.

Nothing really came about from Senator Brownback's 1999 hearings, and then in 2000 one of the most violent FPS games hit store shelves with ***Soldier of Fortune***. Developed by **Raven Software** and published by **Activision**, the game was ranked the number one most violent video game by *Rolling Stone* magazine. As Donald Deane (2013) described, "this stunningly violent first-person shooter uses an aptly-named proprietary damage engine called GHOUL, which breaks character models down into 26 discrete 'gore zones.' In other words, enemies can literally be shot to pieces" (para. 13). Table 7.3 summarizes this and some other video games known for explicit violence and gore.

■ ROCKSTAR GAMES AND CONGRESSIONAL BILLS

A number of other violent titles reached the market in the following years, such as Rockstar Games' ***Manhunt*** in 2003 (Figure 7.14). *Manhunt* puts the player in the shoes of a death row prisoner saved from lethal injection and ordered to execute gang members on closed-circuit television (CCTV) in an attempt to save his family. Stars are awarded to the player for the speed and brutality of the executions. The game caught the attention of U.S. Representative **Joe Baca** (Democrat, CA), who claimed "it's telling kids how to kill someone, and it uses vicious, sadistic and cruel methods to kill" (Gwinn, 2003, para. 8).

PRO FILE

DOUG LOWENSTEIN

KEY FACTS:

Founding president of the ESA (formerly IDSA)

Helped form the ESRB, E3 Tradeshow, and fought matters from piracy to censorship

PRO FILE

HISTORY:

- Born: 1951

EDUCATION:

- Washington University in St. Louis (1973)

CAREER HIGHLIGHTS:

- Legislative Director for U.S. Senator Howard M. Metzenbaum (Democrat, OH) from 1982 to 1986
- Senior Vice President at Robinson Lake Sawyer Miller from 1992 to 1994
- Senior VP at National Strategies, Inc 1986 to '92
- President of the ESA Interactive Digital Sofware Association from June 1994 to Feb. 2007
- Doug helped defeat hundreds of anti-video game legislation bills across the United States

RECOGNITION:

- Recipient of the Lifetime Achievement Award at the 13th Annual Interactive Achievement Awards in Las Vegas, February 18th, 2010

Photo credit: Dan Primack 8/24/11 from http://fortune.com/2011/08/24/private-equity-fires-its-top-lobbyist/

FIGURE 7.13 Screenshots from *Doom* (1993).

TABLE 7.3 Five Video Game Series Known for Their Explicit Violence and Gore

Series	Debuted	Developer(s)	Publisher(s)
Dead Space	2008	Visceral Games	Electronic Arts
Manhunt	2003	Rockstar North	Rockstar Games
Mortal Kombat	1992	Midway Games (and more)	Midway Games, Williams Ent., WarnerBros. Interactive Ent.
Postal	1997	Running With Scissors	Ripcord, Loki Ent., Whiptail Interactive, Akella, RWS
Soldier of Fortune	2000	Raven, Cauldron, Activision	Activision and Activision Value

A year later, Rockstar Games released *Grand Theft Auto: San Andreas*, based on South Central L.A. in the 1990s. Along with its hackable "Hot Coffee" sex scenes, the game contained realistic violence in an open world setting. Examples of violence in *GTA: San Andreas* include shooting police officers, running over pedestrians with vehicles, as well as hijacking a train, among other acts. By March 2005, the game had sold more than 12 million copies, making it the highest selling title for the PlayStation 2.

FIGURE 7.14 Screenshots of (a) *Manhunt* (2003) and (b) *Grand Theft Auto: San Andreas* (2004).

(a)

(b)

The popularity of violent, M-rated games motivated Senator **Hillary Clinton** (Democrat, NY) to introduce a bill called the **Family Entertainment Protection Act (FEPA)** on December 16, 2005, which called for a federal mandate to enforce the ESRB ratings system for video games. Major proposals of the bill included the prohibition on selling mature and adult-only video games to minors, an annual analysis of the ESRB rating system, the authority for the **Federal Trade Commission (FTC)** to investigate misleading ratings, the authority to register complaints, and annual retailer audits. This and similar bills never became laws and eventually expired with no further action.

DID YOU KNOW?

In addition to its numerous "best-selling" records, Guinness World Records (2009) lists *Grand Theft Auto* as the most controversial video game series in history, where more than 4,000 articles have been published on the series (pp. 108–109).

Another attempt to enforce the ESRB ratings and prevent the sale of violent videogames to children was **California bill AB1179**. Introduced by Senator **Leland Yee** (Democrat, CA) and approved by Governor **Arnold Schwarzenegger** (Republican, CA) in October 2005, the bill banned the sale of violent video games to children under 18 and asked for clearer labeling of ratings than what was currently being used by the ESRB. A maximum $1,000 fine would be imposed on retailers for each infraction. The bill passed as **CA Law AB 1793** in January 2006, but only resulted in stores being required to display the ESRB ratings system and to provide parents with information on the ratings.

The Entertainment Software Association (ESA) challenged the law in the United States District Court for the Northern District of California. U.S. District Judge **Ronald M. Whyte** ruled that the law was a violation of the First Amendment. Insufficient evidence that video games were different from other media or caused violent behavior was also part of the decision (Video Software Dealers Ass'n et al. v. Schwarzenegger et al., 2007). Schwarzenegger appealed, but the Ninth Circuit Court of Appeals affirmed Whyte's decision in 2009. Finally, Schwarzenegger appealed to the Supreme Court and hearings were held on November 2, 2010.

Jerry Brown (Democrat, CA) succeeded Schwarzenegger as California governor in 2010 and the case was renamed **"Brown v. Entertainment Merchants Ass'n"** after the hearings (Clements, 2012, p. 680). Once again the ESA was there to defend its case, along with the support of industry giants such as Microsoft, Activision Blizzard, the National Association of Broadcasters, Motion Picture Association of America, and Recording Industry Association of America, among others. Following the deliberations, the Supreme Court struck down the California law as unconstitutional with a 7–2 decision on June 27, 2011. The ruling claimed that video games were protected under the First and Fourteenth Amendments.

Video games have a solid track record of being protected by the U.S. Constitution. While there remains no federal law prohibiting the sale of M-rated video games to minors, most retailers strictly adhere to the ratings set forth by the ESRB. At **GameStop**, "if an hourly employee sells an M-rated game to a minor, not only will he or she lose their job, but the salaried store manager will be terminated as well" (Chester, 2007, para. 2).

FIGURE 7.15 Censored for violence: European game covers (a) versus U.S. covers (b) for *Fahrenheit/Indigo Prophecy* (2005) and *Dead Rising 2* (2010).

(a) (b)

■ EFFECTS OF VIDEO GAME VIOLENCE

Many scientific studies have been conducted on the effects of video games, particularly on the effects of young people who play violent video games. A 2015 policy statement by the **American Psychological Association** claimed that "scientific research has demonstrated an association between violent video game use and both increases in aggressive behavior, aggressive affect, aggressive cognitions and decreases in prosocial behavior, empathy, and moral engagement" (p. 3). Former attorney **Jack Thompson** and studies by **Barbara J. Wilson** of University of Illinois at Urbana-Champagne (2008) and Psychologist **Craig A. Anderson** (2010) support the assertion that exposure to violent video games can contribute to aggressive behavior. Most of these studies revealed **short-term aggression** during or immediately after playing a violent game—similar to a moviegoer feeling sad or depressed during and/or after viewing an emotionally heartbreaking film.

Other social scientists argue that there is no significant **correlation**, such as Associate Professor of Sociology at Western Michigan University, **Whitney DeCamp**. DeCamp acknowledges that some studies have shown a connection between children playing violent video games and violent behavior, but argues that the two variables have been observed "in a vacuum" and that children who are attracted to violent video games likely have a predisposition toward aggression. DeCamp claims, "the evidence points to either no relationship between playing video games and violent behavior or an 'insignificant' link between the two" (Scutti, 2016, p. 2). His study showed that playing violent video games was not a predictor of violent behavior among 6567 eighth-graders.

Associate Professor and Co-Chairman of the Department of Psychology at Stetson University **Christopher Ferguson** claims that "data in studies linking video games and violence have been improperly analyzed … that this research ignores important social factors—such as mental health status and family environment—that can trigger violence, while pinning all the blame on gaming" (Pellissier, 2016, p. 2). Ferguson suggests that rather than video games, it is factors such as antisocial personality traits, depression, family, and peer influence that are more likely to trigger aggressive behavior.

A 2014 study from Ferguson examined the best-selling games from 1996 to 2011 and ranked each game for violent content based on ESRB ratings. For the study, "youth violence was charted over the same time period using a government database of per capita youth violence in ages 12–17. With these two data sets in hand, Ferguson correlated the numbers to see if any trend would emerge. It did. It was *negative"* (Hill, 2014, para. 5). In other words, youth violence rates dropped while the consumption of violent video games increased over the 15 years observed in the study (Figure 7.16).

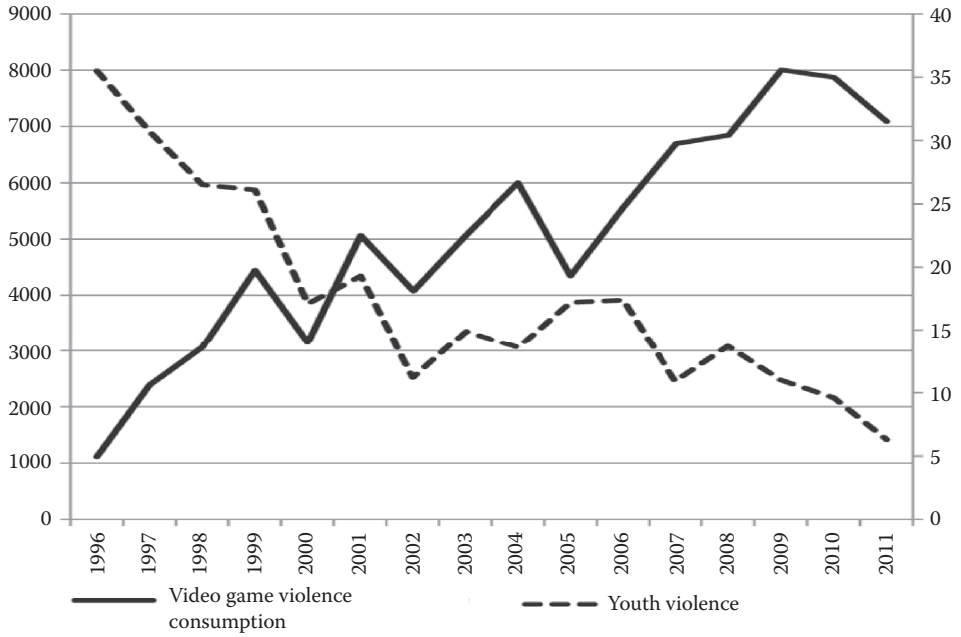
Ferguson's findings were consistent with data assembled by **Nicholas Lovell** of *GAMESbrief* in 2010. Lovell plotted North American software sales figures between 1990 and 2008 and then compared them to the FBI's official violent crime statistics for the United States during that same period. His data showed that during this time software sales grew by 461 percent, while violent crime in the United States had fallen by 25 percent (Lovell, 2010, p. 1). These correlational studies do not prove that playing violent video games decreases violence in society, although they may provide an argument against the claim that violent video game consumption increases youth violence. Ferguson does suggest that "violent video games may help reduce societal violence rather than increase it" (Scutti, 2016, p. 2). The assumption is that by occupying young people with activities they enjoy—including video games—they will stay off the streets and potentially away from trouble.

DID YOU KNOW?

Studies by Gitter et al. (2013) found a significant decrease in aggression of participants who played violent video games with an explicit **prosocial motive** (pp. 346–354).

There is a hypothesis known as **catharsis theory**, which is the belief that "playing violent video games or watching violent TV/movies allows people to 'vent' their aggressive inclinations and therefore behave less aggressively after playing/watching" (Gentile, 2013, p. 492). Rather than becoming more violent, it is possible that many individuals seek violent video games as a form of stress release. This theory is supported by a number of researchers, including **Dr. Henry Jenkins** (MIT/USC),

FIGURE 7.16 Data from Ferguson (2015) showing a decline in youth violence and increase in video game violence consumption from 1996 to 2011.



as well as Nottingham Trent University's Professor **Mark D. Griffiths** (1999) who explains that "it might be precisely the fantasy aggression that releases the energy that would otherwise be expressed as aggressive behavior" (p. 206).

Another concern about video game violence—like other media violence—is **desensitization**, where gamers develop a diminished emotional response to video game violence after repeated exposure to it. A longitudinal study by University of Buffalo's Dr. **Andrew Grizzard** et al. found that repeatedly playing the same violent game reduces emotional responses (such as guilt) both in the original game and in other violent video games as well (2016). The study did not identify how or why the phenomenon occurred, or whether such desensitization could be transferred into real life violent situations.

■ OTHER EFFECTS OF VIDEO GAMES

Like other forms of media, the oversexualization of women, hyper-masculinization of men, or under-representation of minority groups in video games can most certainly influence a gamer's perception of people and society. For instance, several "studies on gender stereotyping suggest that negative representations of female characters in many video games can lead players to learn, emulate, and internalize the values and norms associated with stereotypes of women as sexual objects and victims of violence, who are vulnerable and ineffective (Yang, 2012, p. 72; Brenick, Henning, Killen, O'Connor, & Collins, 2007; Dietz, 1998; Harrison & Cantor, 1997). Likewise, stereotypical representations of male or minority characters in games may also influence players' perceptions regarding masculinity, race and ethnicity, or aspects of sexuality.

The added **interactive component** of video games may give this form of media even more influential power on consumers. While there is still much debate over how much of an influence video games have on players, it can be said with certainty that a vulnerable audience exists—particularly children. The gaming industry and retailers have raised the bar in adopting the ESRB rating system and regulating the sale of video games to minors. Moreover, it is parents who must play the pivotal role in mentoring and monitoring children's consumption of video games—as well as any other form of media.

■ ACTIVITY: VIDEO GAMES DEBATE

Working in groups of two, choose one of the following topics to debate for and against:

1. Video games contain too much violence and gore.
2. Video games contain too much sex and nudity.
3. The majority of today's video games tend to oversexualize women.
4. The majority of today's video games tend to hyper-masculinize men.
5. Most (choose one race) people are underrepresented in today's video games.
6. Most (gay, lesbian, or LGBT) people are underrepresented in today's video games.
7. Violent video games lead to long-term aggressive behavior in game players.
8. Violent video games lead to real life desensitization in game players.
9. (One ethnic or gender group) is presented as a stereotype in most video games.
10. Playing violent video games can relax or help people vent their aggression.

STRUCTURE

The introduction should (1) gain attention through shock, question, humor, example or anecdote, (2) preview the main points of the speech, and (3) cite the hypothesis of the speech.

The body of the debate should contain three main points and two quotes of supporting research from peer reviewed journals that can be paraphrased or cited verbally in the presentation. Sources should be cited in APA format, mentioning both the author(s) and the year of their studies.

The conclusion should close with a memorable summary of your main points. The total length of each debate should be 3–4 minutes, not to exceed 5 minutes total.

GUIDELINES

- The outline must be typed and is due the first day of the debates.
- The outline must include a references page of all cited sources from the presentation.
- The presentation must include a visual aid (such as PowerPoint) that is easy to view.
- Video clips should not exceed more than 20% of the total length of each debate.

■ CHAPTER 7 QUIZ

1. According to the ESA, the age of the average U.S. video game player in 2016 was:
   a. 25 years old
   b. 30 years old
   c. 35 years old
   d. 40 years old

2. U.S. video gamers consist of approximately:
   a. 59% male and 41% female
   b. 69% male and 31% female
   c. 50% male and 50% female
   d. none of the above

3. Which of the following was *not* a reason that sexual themes in video games became more popular in the United States during the 1990s?

a. Improved graphics
b. CD-ROM technology
c. Revocation of the IDSA
d. Advancements in FMV

4. One of the first titles known for strong sexual content was this text-only adventure in 1981 by On-Line Systems where the player is out to win the affections of three women:
   a. Custer's Revenge
   b. The Guy Game
   c. Leisure Suit Larry
   d. Softporn Adventure

5. This company created three adult video games for the Atari 2600, including *Custer's Revenge, Beat 'Em & Eat 'Em*, and *Bachelor Party*:
   a. On-Line Systems
   b. Mystique
   c. Martech
   d. Vivid Interactive

6. Companies such as Koei, Enix, Square, and Nihon Falcom helped create the early demand for Japanese erotic games known as _____ games:
   a. eroge
   b. mahjong
   c. pachinko
   d. none of the above

7. This graphical adventure series was first released in 1987 and follows a story of a 38-year-old virgin on a quest to get lucky in the fictional city of Lost Wages:
   a. Custer's Revenge
   b. The Guy Game
   c. Leisure Suit Larry
   d. Softporn Adventure

8. One of the first CD-ROM games to garner public attention in the United States about a group of females having a slumber party who are under attack by vampire-like beings:
   a. Duke Nukem
   b. Fear Effect
   c. Night Trap
   d. Phantasmagoria

9. This 2004 trivia game hosted by Matt Sadler was controversial for nudity and a lawsuit from one of the contestants who was only 17 years old when the footage was recorded:
   a. Dead or Alive
   b. The Guy Game
   c. Softporn Adventure
   d. You Don't Know Jack

10. This "sandbox" style series game became instantly controversial by placing the player in the role of a criminal—with the ability to pay prostitutes for "services" to recover health, in addition to killing innocent civilians, police officers, and military personnel:
    a. Dead or Alive
    b. Duke Nukem
    c. Fear Effect
    d. Grand Theft Auto

11. Female video game characters have been commonly depicted as:
    a. Damsels in distress
    b. Oversexualized
    c. Sex objects
    d. All of the above

12. Characters of color and LGBT have often been _____ in video games:
    a. excluded
    b. underrepresented
    c. limited to non-playable characters
    d. all of the above

13. The vast numbers of video games on the market tend to be presented through the:
    a. Asian, male perspective
    b. Black, male perspective
    c. Caucasian, female perspective
    d. Caucasian, male perspective

14. An early arcade game that attracted the attention of the media where the object of game is to run over stick figure beings called "gremlins" using a steering wheel and gas pedal:
    a. Death Race
    b. Outrun
    c. Nitro
    d. X-terminator

15. Midway's *Mortal Kombat* was developed by:
    a. John Carmack and John Romero
    b. Ed Boon and John Tobias
    c. Doug Lowenstein and Arthur Pober
    d. Joseph Lieberman and Herb Kohl

16. *Mortal Kombat* and *Night Trap* led to hearings on video game marketing by Senators:
    a. John Carmack and John Romero
    b. Ed Boon and John Tobias
    c. Doug Lowenstein and Arthur Pober
    d. Joseph Lieberman and Herb Kohl

17. ESRB stands for the:
    a. Entertainment Software Rating Board
    b. Entertainment Software Reconciliation Board
    c. Electronic Software Reconciliation Bureau
    d. Electronic Software Ruling Bureau

18. These id Software developers made the first-person shooter genre popular with *Wolfenstein 3D* and *Doom*:
    a. John Carmack and John Romero
    b. Ed Boon and John Tobias
    c. Doug Lowenstein and Arthur Pober
    d. Joseph Lieberman and Herb Kohl

19. Of the following, who has *not* blamed violent video games for influencing real acts of violence in society?
    a. American Psychological Association
    b. Dave Grossman
    c. Henry Jenkins
    d. Jack Thompson

20. Introduced a bill called the Family Entertainment Protection Act (FEPA) in 2005, which called for a federal mandate to enforce the ESRB ratings system for video games:
    a. Arnold Schwarzenegger
    b. Hillary Clinton
    c. Joe Baca
    d. Leland Yee

21. California bill AB1179 was introduced by Senator _____ and approved by Governor _____ in October of 2005.
    a. Leland Yee and Arnold Schwarzenegger
    b. Hillary Clinton and Arnold Schwarzenegger
    c. Joe Baca and Arnold Schwarzenegger
    d. None of the above

22. The hypothesis known as _____ is the belief that playing violent video games is a form of stress release that allows people to vent their aggression.
    a. catharsis theory
    b. desensitization
    c. prosocial motive
    d. short-term aggression theory

True or False

23. In the video game business, FMV stands for "Frequently Modded Video Game."

24. *Grand Theft Auto: San Andreas* (2004) was relabeled with an AO (Adults Only) until its "Hot Coffee" minigame mod could be removed from the game's code.

25. While the oversexualization of female heroines may have declined in the United States, these over-exaggerations continue to be prevalent in many Japanese-developed games.

■ FIGURES

FIGURE 7.1 Box art to *Custer's Revenge* (Mystique, 1982).

FIGURE 7.2 Screenshots and box art to the Amiga version of *Leisure Suit Larry in the Land of the Lounge Lizards* (1987). (On-line Systems, 1987. Courtesy of Wardyga.)

FIGURE 7.3 Screenshots and box art to the original Sega CD version of *Night Trap* (Digital Pictures/Sega, 1992). (Courtesy of Wardyga.)

FIGURE 7.4 Box art to the PS2 version of *The Guy Game*. (Courtesy of Topheavy Studios/Gathering, 2004.)

FIGURE 7.5 Screenshots before a Hot Coffee minigame in *Grand Theft Auto: San Andreas*. (Rockstar North/Rockstar Games, 2004. Courtesy of by Wardyga.)

FIGURE 7.6 Images of an oversexualized woman (Ivy from *Soul Calibur IV*) (a) and a hyper-masculine man (Marcus from *Gears of War*) (b). (Ivy from *Soul Calibur IV* courtesy of Project Soul/Namco Bandai, 2008; and Marcus from *Gears of War* courtesy of Epic Games/Microsoft Studios, 2006.)

FIGURE 7.7 Games like *Mass Effect* allow players to fully customize their characters. (Courtesy of BioWare/Electronic Arts, 2012.)

FIGURE 7.8 The average sexualization of female characters by year of release shows an overall decline in recent years (Lynch et al., 2016, p. 574). (From Lynch, T., Tompkins, J., van Driel, I., & Fritz, N., 2016, August, *Journal of Communication*, 66(4), 564–584.)

FIGURE 7.9 Censored for sexuality: Japanese game covers (a) versus U.S. game covers (b) for *Dead or Alive: Dimensions* (2011), *Shadows of the Damned* (2011), and *Nitroplus Blasterz: Heroines Infinite Duel* (2015). (*Dead or Alive: Dimensions* courtesy of Team Ninja/Tecmo Koei, 2011; *Shadows of the Damned* courtesy of Grasshopper Manufacture/Electronic Arts, 2011; and *Nitroplus Blasterz: Heroines Infinite Duel* courtesy of Examu/Nitroplus and Marvelous Inc., 2015.)

FIGURE 7.10 Screenshot of *Death Race*. (Courtesy of Wardyga.)

FIGURE 7.11 Screenshots depicting the violence and gore from *Mortal Kombat* (1992). (Midway Games, 1992. Courtesy of by Wardyga.)

FIGURE 7.12 Some backside ESRB rating labels with icon and specific content descriptors. (E10+ ESRB rating by ESRB. Retrieved from http://www.gamefaqs.com/wii/959321-rabbids-go-home/images/box-123365, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=12442946. M ESRB Rating. Retrieved from http://www.leviathyn.com/2012/05/23/esrb-ratings-arent-required-or-are-they/)

FIGURE 7.13 Screenshots from *Doom* (1993). (id Software, 1993. Courtesy of Wardyga.)

Figure 7.14 Screenshots of (a) *Manhunt* (2003) and (b) *Grand Theft Auto: San Andreas* (2004). (*Manhunt* courtesy of Rockstar North/Rockstar Games, 2003; and *Grand Theft Auto: San Andreas* courtesy of Rockstar North/Rockstar Games, 2004.)

FIGURE 7.15 Censored for violence: European game covers (a) versus U.S. covers (b) for *Fahrenheit/Indigo Prophecy* (2005) and *Dead Rising 2* (2010). (*Fahrenheit/Indigo Prophecy* courtesy of Quantic Dream/Atari, Inc., 2005; and *Dead Rising 2* courtesy of Blue Castle Games/ Capcom, 2010.)

FIGURE 7.16 Data from Ferguson (2015) showing a decline in youth violence and increase in video game violence consumption from 1996 to 2011. (From Ferguson, C., 2015, *Journal of Communication*, 65, E1–E22.)

Pro File: Doug Lowenstein. Photo courtesy of Doug Lowenstein, 2017. Retrieved from https://convergencyus.com/who-we-are/douglas-lowenstein/.

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The 3D Era

OBJECTIVES

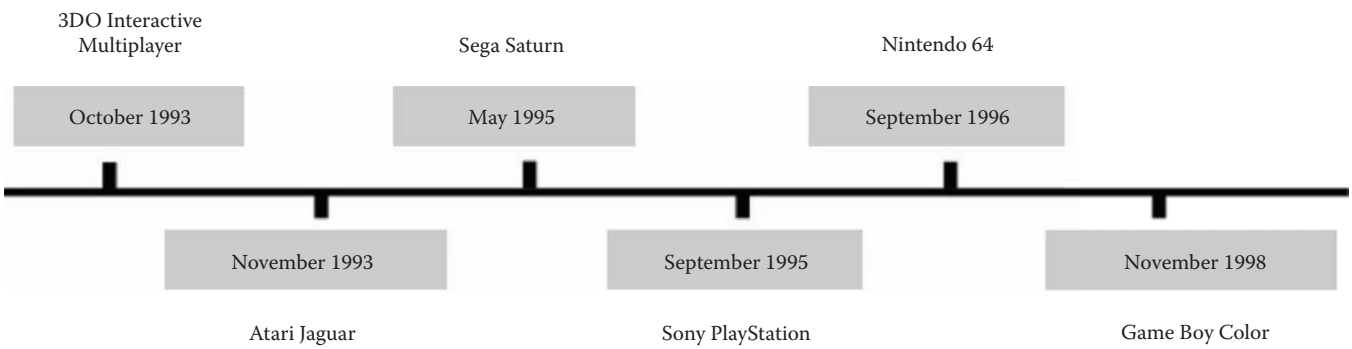
After reading this chapter, you should be able to:

- Describe the move to 3D and its influence on arcades and home video games.
- Discuss why the first wave of next generation consoles (3DO and Jaguar) failed.
- Summarize a brief overview of the history of Panasonic and Sony.
- Recognize key people who helped pave the way for the top games and consoles.
- Explain why the Sega Saturn was less successful in North America.
- Provide reasons for how Sony dominated the fifth-generation market.
- Discuss why Nintendo stayed with cartridge format and its impact on the N64.
- Account for why the Nintendo 64 was less successful in Japan versus the United States.
- List the important innovations brought to gaming during this time period.
- Be familiar with the technological differences among fifth-generation systems.
- Have a sense of the graphics and general capabilities of fifth-generation consoles.
- Review some of the key video game titles for each console.
- Summarize fifth-generation market sales, breakthroughs, and trends.

■ KEY TERMS AND PEOPLE

3D Pad
3D polygon graphics
3DO Company
3DO (Console)
Acclaim
American Laser Games
Anti-Aliasing
Arcade Racer (Wheel)
Atari Jaguar
Atari Panther
Martin Brennan
Compact Disc (CD)
Control Stick
Controller Pak
Copy protection
Daisy chain
Demo disc
Draw distance
Dreamworks
DualShock controller
E3
Electronic Arts
Expansion Pak
Flare Technology
Martz Franz
Game Boy Color
Gamegun
GameWorks
Glove controller
Goldstar
Gouraud shading
Guncon
Phil Harrison
Hitachi SH2 CPU
Home Arcade Systems
Masaru Ibuka
Jaglink
Jaguar CD
Tom Kalinske
Konami
Ken Kutaragi
Licensed Soundtracks
Local area network
Logitech
John Mathieson
Konosuke Matsushita
Memory card
Memory Track
Midway
R. J. Mical
Joe Miller
Jay Miner
MK-80100
Akio Morita
Motorola MC68000
Multiplayer Adaptor
Multitap
Yuji Naka
NEC VR4300
Dave Needle
Hayao Nakayama
Nintendo 64 (N64)
Nintendo 64DD
Norio Ohga
Panasonic
Pirated games
Play Cable
PlayStation Underground
ProController
PSone
Psygnosis
R&D3 Team
Rareware/Rare
Reality coprocessor
Real-time lighting
Redbook audio
Regional lockout
Region-free
David Rosen
Rumble Pak
Sanyo
Hideki Sato
Sega 32X
Sega Netlink
Sega Saturn
Silicon Graphics, Inc.
Sonic Team
Sony Computer Entertainment.
Sony Corporation
Sony PlayStation
Sprite-generated polygons
Squaresoft
Steven Spielberg
Bernie Stolar
Stunner light gun
Taito
Team Tap
Transfer Pak
Transparency
Treasure
Universal Studios
Video compact disc
Video display processor (VPD)
Virtual Boy
Voice recognition unit
Walkman
Andrew Whitaker
Gunpei Yokoi
Yuji Naka

■ CONSOLE TIMELINE



■ ARCADES IN FLUX

The arcade scene in the mid-1990s was popularized by games utilizing **3D polygon graphics**. Sega pioneered the genre with games such as *Virtua Racing* (1992) (shown in Figure 8.1), *Virtua Fighter* (1993), and *Virtua Cop* (1994). Namco went head-to-head with Sega, releasing *Ridge Racer* (1993), *Tekken* (1994), and *Time Crisis* (1995). Racing, fighting, and light gun shooting games were the main draw and most of these games were now costing 50 cents or more to play. According to *Businessweek*, by 1994 Americans were pouring $7 billion into arcade games each year—approximately $1 billion more than they were spending on the home console market at that time (Armstrong, 1994, p. 58).

This renaissance period would only last for so long. **Taito** closed its U.S. offices in 1995 (Kent, 2001, p. 500) and in addition to arcade games becoming more expensive, home video game rentals became more popular and 32-bit home consoles were right around the corner. The new systems were built around 3D polygonal technology and would be able to match the graphics and sound of the arcades more closely than ever before. While arcade hardware continued to be one step ahead and more advanced than home consoles, the gap was beginning to narrow. The average consumer could no longer notice a significant difference between home ports and the original arcade games.

With revenues on the decline again, the arcade industry would see another small resurgence in 1996 when motion picture companies **DreamWorks** (Steven Spielberg) and **Universal Studios** teamed up with Sega to form the arcade mega complex **GameWorks**. The first location had over "35,000 square feet of floor space [and] opened in downtown Seattle in March of 1997. The opening was treated more like a movie premier, with stars such as Will Smith, Gillian Anderson, and Weird Al Yankovic in attendance" (Kent, 2001, pp. 528–529). Openings of GameWorks in other major U.S. cities soon followed.

■ THE 3D ERA

Following in the footsteps of the arcades, the fifth generation was driven by 32- and 64-bit technology, with an emphasis on 3D polygonal graphics. Every console could now display millions of colors on screen, shifting the tech specs focus from colors to polygon count. Not since the second generation were so many home consoles released to the public, with many systems only being available in Japan with a limited library of games. There were close to a dozen consoles released during the fifth generation, with five key systems reaching U.S. shores. This generation also saw the largest release of handheld systems, many of which were complete market failures. This chapter will focus primarily on the major five home consoles that were released and marketed in the United States, Europe, and Japan.

FIGURE 8.1 Screenshots of defining arcade games from the mid-1990s: (a) *Virtua Racing* (Sega, 1992), (b) *Tekken* (Namco, 1994), and (c) *Area 51* (Mesa Logic/Atari 1995).

(a) (b) (c)

FIGURE 8.2 The Panasonic R•E•A•L 3DO Interactive Multiplayer with standard controller.

■ 3DO INTERACTIVE MULTIPLAYER

The first major system console in the fifth generation of game consoles was the **3DO Interactive Multiplayer** (Figure 8.2), developed by Amiga computer and Atari Lynx designers **Dave Needle** and **R. J. Mical** and backed by **Electronic Arts** founder **Trip Hawkins.** The name "3DO" had really no significance. Hawkins told *Retro Gamer Magazine* that he simply wanted the name of the system to end with an "o" like "radio" or "video" and that someone had suggested adding "3D" to the title (Retro Gamer, 2009, p. 189). It was subtitled "Multiplayer" because the system could play video games, music CDs, photo discs, and **video compact discs** (or VCDs).

The business model for the system was unlike any other console. Hawkins derived a plan for his new **3DO Company** to profit by licensing the hardware to multiple electronics manufacturers. Another part of Hawkins's business plan to attract developers was to only collect a small, $3 royalty for every game sold. This was significantly lower than the royalty fees collected by Nintendo and Sega. Thanks to Hawkins's wide network of industry contacts, the system received a lot of media coverage initially, including articles in *The Wall Street Journal, New York Times, Los Angeles Times, San Francisco Chronicle, Chicago Tribune*, and *Businessweek*, among others (Mathews, 2013, p. 21). The 3DO was even awarded *Time* magazine's "1993 Product of the Year."

The first manufacturer to release the system was **Panasonic** on October 4, 1993, followed by a 1994 release in Japan and Europe. Founded in 1918 by **Konosuke Matsushita**, Panasonic became one of Japan's largest electronics producers. Many consumers referred to the system as the "Panasonic 3DO" when the console debuted, however, because of Hawkins's licensing structure, two other companies would go on to manufacture versions of the 3DO, including **GoldStar** and **Sanyo** (see Figure 8.6).

The initial challenge for the 3DO was cost. The technology at that time was costly and for it to be profitable, the 3DO launched at the suggested retail price of $699.99. Games were also sparse. When the 3DO first hit store shelves, the only game available was the pack-in title *Crash 'N Burn*—however as Table 8.1 illustrates, 13 more titles were released by the end of the year. Panasonic eventually lowered the price of the system to $399.95 in 1994, but the excitement for the 3DO had worn off and sales remained low (Kent, 2001, p. 487).

TABLE 8.1 3DO Interactive Multiplayer 1993 U.S. Titles

• 20th Century Video Almanac	• The Life Stage: Virtual House
• The Animals!	• Star Control II
• Battle Chess	• Stellar 7: Draxon's Revenge
• Crash 'N Burn (Figure 8.3a)	• Total Eclipse (Figure 8.3b and 8.4)
• Crime Patrol	• Twisted: The Game Show
• Escape from Monster Manor	• Fatty Bear's Birthday Surprise
• Lemmings	• Guardian War

FIGURE 8.3 Screenshots from early 3DO titles (a) *Crash 'N Burn* and (b) *Total Eclipse.*

(a)

(b)

Despite its slow sales, the 3DO introduced a number of innovations to the home video game market. While its controller design was essentially just a mix between the Genesis and Super Nintendo controller, each additional controller could be plugged into the top of the previous one. This **daisy chain** concept allowed up to eight controllers to be linked together and eliminated the need for more than one controller port on the system or any extra multiport peripheral. The controllers even included a 3.5 mm **headphones jack** and volume control on the bottom side.

FIGURE 8.4 Typical two-page magazine advertisement for the Panasonic 3DO in 1993.

PRO FILE

TRIP HAWKINS

KEY FACT:

Trip Hawkins left his job at Apple Computer in 1982 to found Electronic Arts, which would become one of the largest game publishers.

PRO FILE

HISTORY:

- Born: December 28, 1953 in Pasadena, CA

EDUCATION/CAREER:

- Designed his own major at Harvard University in Strategy and Applied Game Theory, B.A. 1976
- MBA from Stanford University in 1978

CAREER HIGHLIGHTS:

- Director of Strategy and Marketing at Apple
- Founded Electronic Arts in 1982, which promoted its game developers, packaged titles like album covers, and was first to license athletes for video games
- Formed 3DO in 1991, which released the most powerful video game console at the time in 1993
- Launched mobile video game developer Digital Chocolate in 2003

RECOGNITION:

- Hawkins became the eighth person inducted into the Academy of Interactive Arts and Sciences' Hall of Fame in 2005.

TABLE 8.2 3DO Interactive Multiplayer Tech Specs	
Manufacturer:	Panasonic (then GoldStar and Sanyo)
Launch Price:	$699.99
Release Date:	10/04/93 (US), 3/20/94 (JP), 1994 (EU)
Format:	CD-ROM
Processor:	32-bit ARM 60 RISC CPU (12.5 MHz and 32 KB SRAM)
Performance:	20,000 polygons per second (15,000 textured)
Memory:	2 MB DRAM and 1 MB VRAM
Resolution:	640 × 480 (interpolated), 320 × 240 (actual)
Sound:	17 channel, 16-bit stereo (44.1 KHz)

Another innovative feature of the 3DO was that it was one of the first **region-free** systems. In other words, the console did not contain any **regional lockout** components, allowing most international games to be played on domestic systems and vice versa. Unfortunately, 3DO software lacked any **copy protection**, leaving the door wide open for **pirated games** (i.e., illegal copies). The system also became a popular platform for adult film companies like Vivid Interactive to release abridged, erotic VCDs on.

Third-party developer **American Laser Games** designed the "**Gamegun**" light gun for the system to play its popular ports of arcade shooters such as *Mad Dog McCree*. Panasonic and **Logitech** also released a mouse to make it easier to play games such as *Myst* and *Lemmings*. The last popular peripheral was a steering wheel developed by **Home Arcade Systems** for racing games such as *Crash 'N Burn* and *The Need For Speed*.

■ CONSOLE COMPARISON

Compared to its 16-bit predecessors, the 3DO was unlike any other home console on the market at the time of its release. The system was a standalone, CD-ROM system capable of playing more than just video games. A single 3DO CD-ROM could contain up to 650 to **700 MB of data**, compared to just 4 MB of the average Genesis or Super Nintendo cartridge. Where the 16-bit consoles relied on passwords and cartridge batteries to save game data, the 3DO had **32 KB of internal memory** to save games and other data.

Its **12.5 MHz, 32-bit ARM60 RISC** processor (Table 8.2) was both faster and much more capable—delivering tens of thousands of polygons per second. Add textured polygons into the equation and its 3D games looked light years ahead of anything the Super NES could render with its Super FX chip. The 3DO used interpolation, a

FIGURE 8.5 Box art to five defining 3DO titles including: (a) *Star Control II*, (b) *Road Rash*, (c) *Gex*, (d) *The Need For Speed*, and (e) *Super Street Fighter II Turbo*.

(a) (b) (c) (d) (e)

FIGURE 8.6 Other 3DO Interactive Multiplayer systems, including the redesigned (a) Panasonic FZ-10, (b) GoldStar (LG) model, and (c) the Japan-exclusive Sanyo 3DO TRY.

(a) (b) (c)

computer algorithm that essentially upscaled its graphics to **640 × 480** resolution. Finally, its **CD quality sound** and higher storage capacity allowed for **licensed soundtracks**, as heard with music from White Zombie in *Way of the Warrior* and Soundgarden in *Road Rash*.

HEAD-TO-HEAD

Compare the 3DO to its 16-bit predecessors. Try *Starfox* (SNES) versus *Total Eclipse* (3DO), *Super Street Fighter II* (SNES/Genesis) versus *Super Street Fighter II Turbo* (3DO), *Road Rash* (Genesis vs. 3DO version), and *FIFA International Soccer* (SNES/Genesis vs. 3DO).

■ KEY 3DO TITLES

More than 150 games were released for the 3DO in the United States. The system benefitted from an impressive lineup of games published by Electronic Arts, such as *Immercenary, John Madden Football, FIFA International Soccer, Road Rash, The Need For Speed*, and others. **Crystal Dynamics** made a name for itself on 3DO with games like *Total Eclipse, Star Control II*, and *Gex* (seen in Figure 8.5). Interplay published a number of big titles on the system including *Alone in the Dark, Battle Chess, Wolfenstein 3D*, and *Out of This World.*

American Laser Games released around 10 shooter games to support its light gun peripheral, while popular Digital Pictures games such as *Sewer Shark* and *Night Trap* were ported from Sega-CD. These games looked twice as good on the 3DO, with enhanced color and higher screen resolution. Ports of popular arcade fighting games including Capcom's *Super Street Fighter II Turbo* and SNK's *Samurai Shodown* were also well done, however, the two publishers did not really support the system beyond those games.

DID YOU KNOW?

More than 150 games were released for the 3DO in the United States, however, more consoles were sold in Asia than in the United States (Kent, 2001, p. 487). Well over 100 additional games were released exclusively in Japan, including titles such as *Doctor Hauzer*, *Yu Yu Hakusho*, and Hideo Kojima's *Policenauts* (Retro Gamer, 2009, p. 192).

■ ATARI JAGUAR

Atari began work with U.K. computer hardware company **Flare Technology** on its next system around 1989. Flare ended up working on two consoles: a 32-bit system known as the **Atari Panther** to compete in what would become the fourth generation, in addition to its successor—a 64-bit system called **Atari Jaguar** (Figure 8.7). Rapid progress on the Jaguar by Flare engineers **Martin Brennan** and **John Mathieson** resulted in the Panther system being cancelled. After totally missing the last home console market, Atari launched the Jaguar on November 23, 1993 for $249.99. It released in Japan and Europe in 1994.

The Jaguar was built with a total of five main processors contained within three chips. Similar to the TurboGrafx-16 which was called a 16-bit system (even though it only contained an 8-bit CPU), the Jaguar (which contained two 32-bit processors nicknamed "Tom" and "Jerry") was marketed as a 64-bit system. This created some controversy in the gaming world on whether the Jaguar was a true 64-bit system. Atari may have contributed to this ongoing discussion with their advertising, which included the slogan "Do The Math." The system did contain some 64-bit components, however, its third **Motorola MC68000** RISC chip (which acted as a coprocessor) was

FIGURE 8.7 Atari Jaguar and a standard controller with its numeric keypad.

"barely superior to past consoles" (Szczepaniak, 2009, p. 197). These processors, along with incomplete developer instructions, and other architecture issues made it difficult to program games for the Jaguar, ultimately resulting in sparse third-party support.

The system was bundled with one controller and a mediocre 3D shooter called *Cybermorph* (Figures 8.8a and 8.9), which seemed more like an prototype. The game contained no in-game music, very basic polygons, and a very short **draw distance** where polygonal structures (like mountains) would abruptly pop up in front of the player's space ship. Other than *Cybermorph*, the only other title available at launch was the side-scrolling shooter *Trevor McFur in the Crescent Galaxy* (Figure 8.8b). This game also contained no in-game background music and no other titles were released for the system until after the holidays, when a handful of decent titles finally started reaching the market in 1994.

The Jaguar controller contained three main action buttons and two shoulder buttons like the 3DO pad; however, it was quite wide, with curved edges and rounded rolls along the bottom to create an ergonomic feel (Kent, 2001, p. 489). The bottom half of the controller contained a numeric keypad not seen on a game controller since the Atari 5200. This gave the gamepad a unique function that—just like the older consoles—allowed for game-specific overlays to be clipped onto the keypads. While interesting in theory, most gamers found the controllers to be cumbersome and argued they were inferior to the older, Super NES pads (Szczepaniak, 2009, p. 198). Atari later released the **"ProController"** which added three more action buttons, but was just as bulky.

■ CONSOLE COMPARISON: JAGUAR VERSUS 3DO

While each system tried to be innovative, neither the Jaguar nor the 3DO had a great controller. On paper, the Jaguar was technically more powerful, with its **two 32-bit processors** (Table 8.3), each running more than

FIGURE 8.8 Screenshots from the two Jaguar U.S. launch titles (a) *Cybermorph* and (b) *Trevor McFur in the Crescent Galaxy*.

(a)

(b)

FIGURE 8.9 Page two of a multipage magazine advertisement for Atari Jaguar in 1994.

TABLE 8.3 Atari JaguarTech Specs	
Manufacturer:	Atari
Launch Price:	$249.99
Release Date:	11/23/93 (US), 6/27/94 (EU), 11/21/94 (JP)
Format:	Cartridge (w/CD add-on)
Processors:	32-bit Custom RISC processor ("Tom") (26.59 MHz)
	32-bit GFX Processing Unit ("Jerry") (26.59 MHz)
	Motorola MC68000 RISC chip (13.295 MHz)
Performance:	10,000 polygons per second
Memory:	2 MB main RAM
Resolution:	720 × 576
Sound:	16-bit Stereo

double the speed of the 3DO's single RISC processor. Its full, **720 × 576** resolution was also greater than the 3DO's 640 × 480 interpolated display. However, besides being difficult for programmers to take full advantage of the Jaguar's capabilities, this was the dawn of the 3D generation and the 3DO could push **twice the amount of polygons** on screen. While its CD-ROM drive may have added additional loading times to its games, 3DO discs could hold over 100 times more data compared to a **6 MB Jaguar cartridge**. Furthermore, the 3DO's CD quality soundtracks from licensed artists gave it a major edge in the sound department.

After talking about it for years, Atari released a CD console add-on called the **Jaguar CD** (along with a **Memory Track** cartridge for saving CD game data) on September 21, 1995. Priced $149.95, the Jaguar CD never caught on and only a dozen games were officially released for it. Beyond this, the other main peripherals for the system included a **Team Tap** adapter to connect up to four controllers, and a link cable called the **JagLink** for **local area network (LAN)** gaming between two consoles. Just two licensed games utilized the JagLink, including *Doom* and the lesser-known *Aircars*.

■ KEY ATARI JAGUAR TITLES

Only around 67 licensed titles were released during the initial lifespan of the Jaguar. Among those games were an even smaller number of standout titles. One of the first key titles was an update to arcade classic *Tempest*. *Tempest 2000* was developed by **Jay Miner** and released on April 1, 1994. October 20th of that year saw the release of *Alien vs. Predator* by **Andrew Whitaker**. This first-person shooter was unique because it "could be played from the perspective of the space parasites from the movie *Alien*, the intergalactic hunter from the movie *Predator*, or a space marine" (Kent, 2001, p. 489).

The system also received excellent ports of id Software's *Wolfenstein 3D* and *Doom*, however, like many other Jaguar titles, *Doom* lacked background music.

FIGURE 8.10 Box art to five defining Jaguar titles including: (a) *Alien vs. Predator*, (b) *Wolfenstein 3D*, (c) *Rayman*, (d) *Doom*, and (e) *Tempest 2000*.

(a) (b) (c) (d) (e)

FIGURE 8.11 The Sega 32X on the top of a Model II Sega Genesis, on top of a Sega CD II.

Ubisoft's *Rayman* began as a Jaguar exclusive (Retro Gamer Team, 2014, para. 10) and is one of the best side-scrolling titles on the system—albeit weaker sound compared to its CD siblings. In addition to the titles depicted in Figure 8.10, Eclipse Software's *Iron Soldier* games were also notable first-person mech shooters.

HEAD-TO-HEAD

To compare the graphics and sound between the Jaguar and 3DO, check out *Total Eclipse* (3DO) versus *Cybermorph* (Jaguar), *Killing Time* (3DO) versus *Alien vs. Predator* (Jaguar), plus *Flashback, Soccer Kid*, and *Wolfenstein 3D* released on both systems.

■ SEGA 32X AND SATURN

Sega's first entry into the 32-bit arena was the cartridge-based **Sega 32X** (Figure 8.11) by **Joe Miller** and **Martz Franz**—an add-on unit for the Sega Genesis released in the United States for $159. Like the Power Base Converter, the 32X plugged into the cartridge slot of the Genesis and had its own slot to insert 32X games. It contained two **Hitachi SH2 32-bit RISC CPUs** and a **3D graphics** processor that allowed up to **32,768 on-screen colors** and could render **50,000 polygons** per second. Its main purpose was to give American consumers a low-cost, 32-bit experience until its next original system launched. What was not known during the time of its development was that the 32X would release in the United States on November 21, 1994—just one day before the 32-bit standalone **Sega Saturn** system (Figure 8.12) launched in Japan. The unit sold out during the holiday season, but sales plummeted once it was learned that 32X games would not be compatible with Saturn—which was right around the corner.

While the 32X failed to make a lasting impression on U.S. consumers, the Saturn launch was a huge success in Japan. Developed by a team supervised by **Hideki Sato** and debuting at 44,800 yen (approximately $469), Sega sold its entire first shipment of 200,000 units thanks to the popularity of launch title *Virtua Fighter* (Kent, 2001, p. 201). Naturally, Sega wanted to carry its momentum with the Saturn to the United States as soon as possible. Saturn had planned a "Saturnday" launch in the United States for Saturday, September 2, 1995. However, about four months earlier on May 11th at the **Electronic Entertainment Expo (E3)** video games conference in Los Angeles, Sega president **Tom Kalinske** revealed that the console had secretly released that very same day (Buchanan, 2008, para. 2).

The surprise announcement caught many off guard, including third-party publishers who were still developing games for the September launch—as well as retailers who were not included in the early release.

FIGURE 8.12 Sega Saturn with the original U.S./European MK-80100 controller.

FIGURE 8.13 Sega Saturn launch titles *Panzer Dragoon* (a) and *Virtua Fighter* (b).

(a)

(b)

Sega shipped 30,000 systems to four major retailers including Toys "R" Us, Electronics Boutique, Software Etc., and Babbage's. This resulted in Sega losing Kay*Bee Toys, who responded by dropping the Saturn from its catalog all together (Kent, 2001, pp. 516–157). No third-party developed games were available for the launch, resulting in just five launch titles developed and published by Sega (Table 8.4). The launch price was set to $399, which while lower than its initial cost in Japan, was still considered a high price tag for a video game system in the United States during that time period.

A lot of the decisions Sega made for the Saturn may have been influenced by news of the upcoming game console by Sony. The Saturn was initially designed to be a powerful 2D console with secondary 3D abilities, capable of emulating Sega's top arcade games of that time. However, news of Sony's 3D architecture sent Sega back to the drawing board and the Saturn was completely redesigned with "two RISC processors, along with dual **VPDs [video display processors]**" (McFerran, 2009, pp. 204–206). It also contained 32 KB of internal memory for saving games and a cartridge slot for additional storage. However, like the Jaguar before it, its complex architecture (including its rectangular, 2D **sprite-generated polygons**) made the system difficult to program for.

For the U.S. version of Saturn, Sega changed the color of the system from gray (with blue and dark gray highlights) to all black. The controller looked a lot like the six-button Genesis game pad, with the inclusion of two shoulder buttons. It was redesigned for North America and Europe, most likely as an attempt to accommodate the larger hands of western consumers. Known only by its model number, the **MK-80100** controller "is functionally identical to its Japanese cousin, but is slightly larger and has a peculiar concave D-Pad, not seen in a Sega console since. This particular model is often regarded to be worse than the Japanese variant, and was replaced entirely during the summer of 1996, cutting costs as the console was redesigned" (Sega Retro, 2016, para. 3). The second controller was essentially a black version of the original Japanese Saturn controller, with a traditional D-pad and a smaller casing. Also like in Japan, the controller came in several colors, including black, gray, white, and clear.

For peripherals, Sega released the **Stunner** light gun (known as the "Virtua Gun" in Japan), a **3D pad** designed to work with *NiGHTS into Dreams*, as well as an **Arcade Racer** steering wheel. Sega also introduced a **Play Cable** that (like Jaguar's Jag Link) could connect two Saturn consoles for multiplayer LAN gaming. Its **Multiplayer Adaptor** allowed up to six controllers to be

TABLE 8.4 Sega Saturn U.S. Launch Titles

- Clockwork Knight
- Daytona USA
- Panzer Dragoon (Figure 8.13a)
- Virtua Fighter (Figure 8.13b)
- Worldwide Soccer: Sega International Victory Goal Edition

TABLE 8.5 Sega Saturn Tech Specs	
Manufacturer:	Sega Electronics
Launch Price:	$399.99
Release Date:	11/22/94 (JP), 5/10/95 (US), 7/08/95 (EU)
Form at:	CD-ROM(2× speed)
Processors:	2 Hitachi SH2 32-bit CPUs (28.63 MHz) + 2 VPDs
Performance:	500,000 polygons per second (200,000 textured)
Memory:	5 MB total RAM
Resolution:	320 × 224, 640 × 224, and 704 × 480 pixels
Sound:	Motorola 68EC000–32 channel, 16-bit stereo at 44.1 KHz

plugged into each main controller port, while the **Sega NetLink** 28.8k modem allowed for online capabilities such as email. The system also received a joystick, memory cartridges, keyboard, and mouse, among other devices.

■ CONSOLE COMPARISON: SATURN VERSUS 3DO AND JAGUAR

Compared to the first wave of fifth-generation consoles, the Saturn was a faster system with its **dual Hitachi processors (28.63 MHz)** and two video display processors (Table 8.5). The **VDP1** handled sprites, polygons, and geometry, while the **VDP2** managed games' backgrounds (Base Media, 2016, p. 2). Its games often displayed higher frames per second (FPS) compared to 3DO and Jaguar games. With dismal sales of the Atari Jaguar, Saturn's main competitor at the time of its release was the 3DO. Saturn games typically looked sharper, with displays up to **704 × 480 pixels**, compared to the 640 × 480 (interpolated) resolution on the 3DO. The Saturn could display 13–25 times more polygons per second; however, most games released on both systems looked relatively similar. Both 3DO and Saturn had CD quality sound, but the Saturn had nearly twice the number of sound channels, with **32 channels of sound** for programmers to work with.

HEAD-TO-HEAD

To compare the graphics and sound between the Saturn and 3DO, try (or watch video clips of) *Road Rash, The Need For Speed, Primal Rage*, and *Gex*. Compare Saturn to Jaguar with each console's version of *Rayman*, *NBA Jam, Worms*, and *Tempest 2000*.

■ KEY SATURN TITLES

Saturn became known for a number of exclusive titles such as its *Panzer Dragoon* and *Virtua* series (Figure 8.15), as well as strong RPGs like *Shining Force III*

FIGURE 8.14 Box art to five popular Saturn titles including: (a) *Shining Force III*, (b) *NiGHTS into Dreams*, (c) *Virtua Fighter 2*, (d) *Panzer Dragoon Saga*, and (e) *Guardian Heroes.*

(a) (b) (c) (d) (e)

FIGURE 8.15 Magazine advertisement for the Sega Saturn in 1996.

(shown in Figure 8.14), *Magic Knight RayEarth*, and *Dragon Force*. It was the strongest console for 2D platformers such as *Astal* and numerous 2D shoot 'em ups, along with being the best platform to play 2D fighters such as *Marvel Super Heroes* and *Street Fighter Alpha 3*. Furthermore, Saturn was the only system in which gamers could play *NiGHTS into Dreams*, the new title by *Sonic the Hedgehog* creator **Yuji Naka** and **Sonic Team**.

Unfortunately, the Saturn also became known for the games it did not receive. After many development struggles, Sega ended up cancelling *Sonic X-treme*, leaving the Saturn without an exclusive *Sonic the Hedgehog* platformer, other than a graphically enhanced port of the Genesis game *Sonic 3D Blast*, a compilation game called *Sonic Jam*, and the racing title *Sonic R* (McFerran, 2009, p. 208). And because the Saturn wasn't as popular in the West, many excellent titles such as *Radiant Silvergun, Keio Flying Squadron 2, Princess Crown*, and *X-Men vs. Street Fighter* never reached U.S. shores.

■ CHANGES AT SEGA

While Saturn sales remained strong in Japan, the system struggled in the United States and Sega of Japan officials blamed Sega of America for its problems. In America, Sega sold over 2 million Genesis systems in 1995 and did not have enough units to meet the holiday demand. According to Sega of America president and CEO Tom Kalinske, Sega could have sold an additional 300,000 Genesis systems between November and December, if the company not been so focused on the Saturn (Business Wire, 1996, p. 1). Kalinske reportedly began to feel powerless after long-standing disagreements like this with Sega of Japan and announced his resignation on July 15, 1996 (Kent, 2001, p. 535). His announcement was soon followed by the resignation of Sega co-founder **David Rosen** that same year.

DID YOU KNOW?

Of the more than 600 total titles released for the Sega Saturn, only around 250 of these games were released in the United States. Even fewer titles made it to Europe.

■ SONY PLAYSTATION

Sony Corporation was founded in 1946 by **Akio Morita** and **Masaru Ibuka**. Similar to "Sega" and "Famicom," the name "Sony" was derived from a combination of two words: "**so**nus," which is Latin for sonic and sound, and "son**ny,**" which was a slang word for "boy" in the United States (Sony Japan, 2011, p. 1). Sony became a leading electronics manufacturer from its many innovations and diversified business ventures. After its success with manufacturing transistor radios, Sony invented the world's first portable music player with its **Walkman** in 1979. The company went on to pioneer video formats **Betamax** and **Video8**, its own line of computers, **3.5" floppy disks**, as well as **Digital Audio Tape (DAT)** in the 1980s. Sony was also one of the leading developers of **Compact Disc (CD)** and later **Blu-ray Disc** optical disc formats. Sony had a foot in just about all consumer electronics by the late 1980s and the home video game market was next.

The **Sony PlayStation** (Figure 8.16) began as a CD-ROM expansion unit for the Super Nintendo in 1988. Designed by engineer **Ken Kutaragi** (who developed the SNES sound chip), "Sony made sure that it held the sole

FIGURE 8.16 The Sony PlayStation video game console with original d-pad controller.

TABLE 8.6 Sony PlayStation U.S. Launch Titles

- Battle Arena Toshinden (Figure 8.17a)
- ESPN Extreme Games
- Kileak: The DNA Imperative
- NBA Jam Tournament Edition
- Power Serve 3D Tennis
- Raiden Project
- Rayman
- Ridge Racer (Figure 8.17b)
- Street Fighter: The Movie
- Total Eclipse Turbo

international licensing rights—in other words, it would profit handsomely from every single SNES CD-ROM title that was sold" (McFerran, 2010, p. 47). Nintendo had second thoughts about the deal and "allowed Sony to announce plans for the drive at the [1991] Consumer Electronics Show, then appeared the next day to say that they had struck up a deal with Philips … instead" (Kent, 2001, p. 452). The embarrassment from Nintendo's announcement, coupled with the time and money Sony had invested in the PlayStation provoked Sony president **Norio Ohga** and Kutaragi to continue developing the project as a standalone system.

After years of further development and the newly formed **Sony Computer Entertainment (SCE)** division, the Sony PlayStation was released on December 3, 1994 in Japan and in the United States on September 9, 1995 for $299. The system was not initially bundled with a launch title, but did include a **demo disc** containing samples of several games. Due to the low cost of CD-ROMs, these demo discs became a popular medium for advertising, leading to Sony's **PlayStation Underground** disc series featuring demos, articles, interviews, game trailers, and more. Other publications on CDs soon followed.

While its 10 launch titles included a handful of 2D games (see Table 8.6), the PlayStation was built to be a 3D powerhouse. Its single processing chip contained a 3D geometry engine in its CPU which made PlayStation an easy system to program games for, and a liberal $10 per game licensing fee helped Sony attract nearly 100 game companies by the time the system launched in the United States (Kent, 2001, p. 504). Sony aggressively pursued third-party developers, obtaining the support of Sega rival Namco (*Tekken, Ridge Racer*) and acquiring the Liverpool-based developer **Psygnosis** (*Destruction Derby, WipEout*). Executive VP of SCE of America **Bernie Stolar** also helped secure key third-party deals.

Another part of Sony's marketing strategy was to appeal to the specific age of 19 (see Figure 8.18). Executive VP of SCE Europe **Phil Harrison** (2005) explained that the idea behind the strategy was that younger teenagers wished they were 19, while older adults often wished they were 19 (again) as well. Early marketing slogans were clever secret messages created to get gamers talking about the system. For example, "ENOS Lives" was almost SONY written backwards. It could also be interpreted as "Ready Ninth of September," with the red E meaning 'ready' and 'NOS' standing for 'Ninth of September' (Oravasaari, 2012, para. 2). Another slogan "U R NOT E" was a lot easier to decode.

FIGURE 8.17 Screenshots from PS launch titles (a) *Battle Arena Toshinden* and (b) *Ridge Racer*.

(a)

(b)

FIGURE 8.18 1995 PlayStation magazine ad featuring Sofia from *Battle Arena Toshinden*.

Aesthetically, the system was sleek and simplistic. Its light gray color was reminiscent of previous Nintendo consoles and helped it stand out where all the other new systems were shades of black (save for the Japanese version of Saturn). Even its controller looked like an enhanced SNES controller with its face buttons layout and shoulder triggers—adding two additional shoulder buttons, comfortable handles, and a unique d-pad which was comprised of four separate directional buttons. Above the controller ports on the system were two **memory card** slots where separate memory cards could be inserted for saving game data. Like its CD-based predecessors, the PlayStation could also play music CDs in addition to games.

The PlayStation received the standard array of peripherals, including memory cards, light guns like Namco's **GunCon**, joysticks, steering wheels, and other third-party controllers, dance pads for games like *Dance Dance Revolution*, **Multitap** adaptors, link cables, and so forth. Eventually, Sony unveiled its **DualShock controller**, which added touch sensitive control and a vibration feature made popular by Nintendo's fifth-generation system discussed next in this chapter. Later, a more compact version of the console was released as the **PSone** (Figure 8.19), including a portable version with its own LCD screen.

■ CONSOLE COMPARISON: SONY PLAYSTATION VERSUS SEGA SATURN

Table 8.7 summarizes the major technical specifications of the Sony PlayStation. Unlike the Sega Saturn (and even 3DO), the PlayStation did not contain internal storage, making the purchase of a memory card mandatory for players to save game data. True to the nature of how the machines were conceived, Saturn was the more powerful system for 2D games (such as *Marvel vs. Capcom*), while the PlayStation typically delivered better 3D games (as seen in *WipEout*). Technically, Saturn was the more powerful system with more total RAM, higher screen resolutions, greater polygon counts, and 25% more sound channels to work with. However, its complex, dual processor architecture made the Saturn difficult to program for and much of its power often went underutilized.

DID YOU KNOW?

Many PlayStation and Saturn games (plus a few other CD-ROM systems) used standard **redbook audio** tracks for sound. Specifically, audio tracks (often the game's soundtrack) could be played by inserting the game disc into a standard CD player.

What really gave the PlayStation the edge was that it contained a built-in special effects processor. For instance, effects like **transparency** and **Gouraud shading** (which gave graphics a smoother, more detailed look) could be generated by the PlayStation with minimal impact on the system's performance. For Saturn to emulate similar effects, the system had to pull extra processing power, which often meant programmers had to lower their games' resolution to 320 × 224 or abandon such effects altogether. Lastly, Sony's single processor ran at **33.8688 MHz**—slightly faster than either of Saturn's processors.

FIGURE 8.19 The smaller "PSone" with matching DualShock controller and memory card.

TABLE 8.7 Sony PlayStation Tech Specs	
Manufacturer:	Sony Computer Entertainment
Launch Price:	$299.99
Release Date:	12/03/94 (JP), 9/09/95 (US), 9/29/95 (EU)
Format:	CD-ROM (2× speed)
Processor:	32-bit MIPS R3000A RISC CPU (33.8688 MHz)
Performance:	360,000 polygons per second (180,000 textured)
Memory:	2 MB main RAM, 1 MB video RAM, 512 KB sound RAM
Resolution:	256 × 224 to 640 × 480
Sound:	24 channel, 16-bit stereo at 44.1 KHz

HEAD-TO-HEAD

Compare the graphics and sound between PlayStation and Saturn, check out (or watch video clips of) *Marvel vs. Capcom*, *WipEout*, *Tomb Raider*, and *Dead or Alive*.

■ KEY PLAYSTATION TITLES

Ease of programming and aggressive marketing helped Sony lock down a number of quality titles. Around 2000 games were developed for the PlayStation worldwide. Many series were born on and/or exclusive to the system and spawned numerous sequels, such as *Tekken*, *Crash Bandicoot*, *Spyro the Dragon*, and *Twisted Metal*. *Tomb Raider* helped revolutionize 3D platformers and Laura Croft (shown in Figure 8.20) became synonymous with the system, with many of the *Tomb Raider* sequels exclusive to PlayStation on the home console market.

One of the most pivotal acquisitions for Sony was when RPG developer **Squaresoft** abandoned Nintendo, selecting the PlayStation as the sole console for its epic *Final Fantasy VII* game because it was so massive that it required the use of three CDs. This was followed by other Squaresoft exclusives including *Final Fantasy VIII* and *IX*, *Xenogears*, *Chrono Cross*, *Einhänder*, *Parasite Eve*, and many other highly regarded titles. To top it off, **Konami** chose the system for its hit titles *Metal Gear Solid* and *Silent Hill*, while Sony Computer Entertainment's *Gran Turismo* racing games became the company's best-selling series of all time, shipping more than 20 million units combined.

DID YOU KNOW?

The first models of the PlayStation used plastic parts in the laser unit that wore out over time, leading to skipping FMV, audio dropouts, and other issues. Gamers discovered they could alleviate these problems by flipping the system upside down.

FIGURE 8.20 Box art to five defining PlayStation titles including: (a) *Resident Evil*, (b) *Final Fantasy VII*, (c) *Tomb Raider*, (d) *Metal Gear Solid*, and (e) *Tekken 3*.

(a) (b) (c) (d) (e)

■ NINTENDO 64

A year before Nintendo's next home console launch, the company released its **Virtual Boy** (Figure 8.21), a portable, 32-bit table-top console capable of displaying monochrome 3D graphics using red LED technology. The system was developed by **Gunpei Yokoi** (*Metroid*, Game Boy) who "looked into making a color version of the technology but found that it would have to retail for over $500, far too expensive" (Kent, 2001, p. 514). The resulting red and black head-mounted display became notorious for causing dizziness, nausea, and headaches. The system was a commercial failure and discontinued in less than a year.

Nintendo's next home console would go through a couple of name changes over the course of its development. Originally called "Project Reality" (based on the name of its co-processor), the system became known as "Ultra 64" for quite some time before being changed to **Nintendo 64 (N64)** (Figure 8.22) shortly before its launch in Japan on June 23, 1996. Despite the Virtual Boy's failure, the N64 sold its entire launch inventory of 300,000 units in Japan, and all 500,000 launch units in the United States the following fall.

Originally scheduled to release in North America on September 30, 1996 (see Figure 8.24) for $249.99, the system released one to three days earlier for just $199.99. The price drop was most likely in response to Sony, who had recently dropped the price of the PlayStation to $199. Only two launch titles were available for the U.S. release, including *Super Mario 64* and *Pilotwings 64* (Figure 8.23)—but both were strong titles. Marketing slogans used for the console included "Change the System" and "Get N, or get Out!"

FIGURE 8.21 Virtual Boy.

The system's 64-bit CPU was developed by TurboGrafx-16 and PC manufacturer **NEC**, along with its **"Reality" co-processor** (RCP) by **Silicon Graphics, Inc.** (SGI). Its 93.75 MHz main processor was the fastest on the home console market. The Reality co-processor consisted of a Reality Signal Processor (RSP) and Reality Display Processor (RDP), providing many enhancements not seen on other consoles such as **real-time lighting** effects

FIGURE 8.22 The Nintendo 64 with its unique, three-handle controller.

FIGURE 8.23 Screenshots from N64 U.S. launch titles (a) *Super Mario 64* and (b) *Pilotwings 64*.

(a)

(b)

and **anti-aliasing** (edge smoothening). The system also included four controller ports—something not seen on the home console market since the Atari 5200. A memory expansion slot was included between the power and reset buttons where an **Expansion Pak** could be inserted to increase the console's RAM from 4 MB to 8 MB.

A game cartridge slot was located in the expansion slot and Nintendo's decision to stay with the cartridge format for the N64 was not without controversy. It was the main reason Squaresoft moved to the PlayStation for *Final Fantasy VII* and other titles. Many gamers saw CD-ROM technology as the future, with its 700 MB storage capacity, superb audio, and full motion video capabilities. The average N64 cartridge was only 8 to 24 MB, with its largest game pack being Capcom's *Resident Evil 2* which was 64 MB.

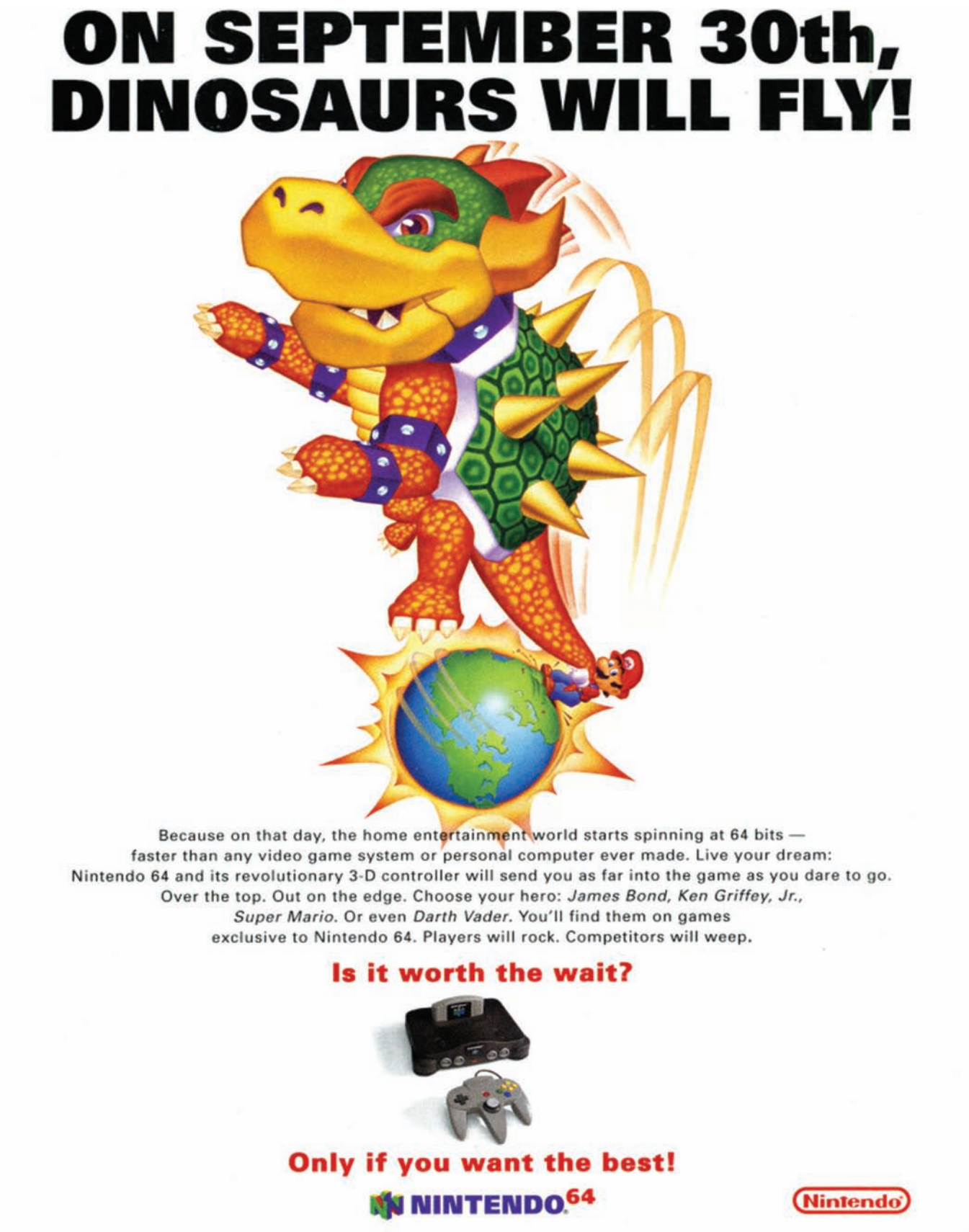
An ideal format for younger gamers, cartridges could not be scratched like CDs, did not contain long loading times, and could save data internally, without the need for an external memory card. While more expensive to manufacture, "Nintendo still controlled their production, [and] profited directly from every one made. Cartridges were also harder to pirate, which is likely to be another reason for sticking with that format" (Retro Gamer, 2009, p. 221). While it may have made sense at the time, the N64 would become the last major home console to use cartridges as its primary media format.

One of the most distinguishing features of the N64 was its three-pronged, M shape controller designed by Nintendo's **R&D3** team. The left handle housed a traditional d-pad and left should trigger; the center handle provided access to the digital **"control stick"** and center "Z" trigger; while the right handle housed the "A" and "B" buttons, four smaller "C" buttons, and a right shoulder trigger. The underside of the controller included an expansion slot where a number of accessories could be inserted, such as the **Controller Pak** for saving data, the **Rumble Pak** which provided force feedback, as well as the **Transfer Pak** for moving game data between Game Boy and N64. The controller was designed to be held in multiple ways and may have been a bit intimidating for some gamers. However, its touch sensitive (analog-style) control stick and force feedback revolutionized the way all future game controllers would be designed.

DID YOU KNOW?

While the Nintendo 64's digital control stick revolutionized video game controllers and developed the standard in which 3D games would be played, it was not the first console with a touch sensitive control stick. That credit goes to the Atari 5200.

FIGURE 8.24 Magazine advertisement for the Nintendo 64 gaming console from 1996.



Aside from the numerous "Pak" add-ons, the N64 did not have a ton of peripherals other than a cleaning kit, **Glove Controller** (similar to the NES Power Glove), **Voice Recognition Unit (VRU),** which was only compatible with two games, a mouse (available as a pack-in with *Mario Artist*), and the **Nintendo 64 Disk Drive (64DD)** add-on that only received around 10 games and was never released outside of Japan.

■ CONSOLE COMPARISON: NINTENDO 64 VERSUS PLAYSTATION

The Nintendo 64 controller was innovative for its time with its M-shape configuration and its touch sensitive digital control stick. However, the control stick tended to loosen over time—something that wasn't much of a problem with the PlayStation's Dual Shock controller sticks. Furthermore, the N64 controller required the separate Rumble Pak accessory to be inserted into the controller's memory cartridge slot for vibration feedback, where the PlayStation's Dual Shock had the force feedback feature built in. On the contrary, the N64 had four controller ports, where Sony's system only contained two.

Nintendo 64's **NEC VR4300** processor (Table 8.8) made it the fastest system on the market at **93.75 MHz**—2.77 times the clock rate of the PlayStation. The N64 had more memory, with **4 MB** versus Sony's 2 MB. Nintendo's system ran at 4.26 times the bus speed and its 64-bit **graphics processing unit (GPU)** was also more powerful. Sticking with cartridge format meant that N64 games benefitted from next to no loading times versus CD-ROM games; however, their smaller storage space meant less quality sound and full motion video. Many titles appearing on both systems had lower quality music, less dialog, and/or lower quality/missing FMV on the N64 version.

For internal memory, the N64 only had **4 KB of texture memory**, compared to the PlayStation's 1 MB of dedicated video memory. "This meant that developers had to make serious concessions in texture design. Two common solutions were to either tile small textures across a surface or resort to Gouraud shading of polygons instead of proper textures" (White, 2014, para. 10). Comparing similar titles on each system, PlayStation games often ran at smoother frame rates and looked sharper but more pixilated, while N64 games had a lower frame rate, with a smoother (sometimes blurry) look.

Both consoles could run games at low and high resolutions (up to 640 × 480), but the PlayStation could push far more polygons at 360,000 polygons per second, compared to roughly **100,000 maximum polygons** in most N64 games. On the other hand, the N64 contained better texture filters such as anti-aliasing, which smoothened the edges of otherwise jagged graphics. For

TABLE 8.8 Nintendo 64 Tech Specs

Manufacturer:	Nintendo
Launch Price:	$199.99
Release Date:	6/23/96 (JP), 9/29/96 (US), 3/01/97 (EU & AU), 12/10/97 (BR)
Format:	Cartridge
Processors:	64-bit NEC VR4300 CPU (93.75 MHz) Reality co-processor (RCP) for GFX and sound (62.5 MHz)
Performance:	100,000 polygons per second (up to 160,000 PPS)
Memory:	4 MB RDRAM (expandable to 8 MB with Expansion Pak)
Resolution:	256 × 224, 320 × 240, and 640 × 480 pixels
Sound:	100 channel, 16-bitstereo at 44.1 KHz (up to 48 KHz)

FIGURE 8.25 Box art to five defining Nintendo 64 titles: (a) *The Legend of Zelda: Ocarina of Time*, (b) *Perfect Dark*, (c) *Super Mario 64*, (d) *Goldeneye 007*, and (e) *Banjo-Kazooie*.

(a) (b) (c) (d) (e)

many gamers, the debate on which system had better graphics was a matter of personal preference.

HEAD-TO-HEAD

Compare the graphics and sound between the N64 and PlayStation by playing (or watching video clips of) *A Bug's Life, Mortal Kombat 4, Quake II, Rayman 2, Resident Evil 2, Tony Hawk's Pro Skater 2*, and *Toy Story 2*.

■ KEY NINTENDO 64 TITLES

Around 380 titles were released for the N64, with the majority of titles reaching U.S. shores. Some of the best games on the system were made by the British developer of *Battletoads* and *Donkey Kong Country*, **Rareware** (Rare). "From the regal beauty and genius of the *Banjo-Kazooie* games, the addictiveness of *Diddy Kong Racing*, to the offbeat destructive nature of *Blast Corps*, and the frantic bug blast of *Jet Force Gemini*, Rare games were held in high esteem and rivaled the releases of Nintendo itself" (Retro Gamer, 2009, p. 222). The company was responsible for the hit fighting game *Killer Instinct Gold*, the hilariously mature 3D platformer *Conker's Bad Fur Day*, in addition to two of the best first-person shooters on the system with *Goldeneye 007* and *Perfect Dark* (in Figure 8.25).

Other major third-party support came from companies like **Acclaim** (*Turok, Extreme-G*), Electronic Arts (*Madden, FIFA*), Konami (*International Superstar Soccer, Castlevania*), and **Midway** (*Mortal Kombat, NFL Blitz*). **Treasure** only produced a few titles, but each one was superb, such as *Mischief Makers* and *Sin and Punishment* (Japan).

Nintendo developed many first-party classics for the system, with *Super Mario 64* and *The Legend of Zelda: Ocarina of Time*—two of the highest rated video games of all time. Other first-party hits included *The Legend of Zelda: Majora's Mask, Wave Race 64, 1080: TenEighty Snowboarding, Star Fox 64, F-Zero X, Pilotwings 64*, and *Mario Kart 64*. Nintendo also published *Excitebike 64* by Left Field Productions, *Super Smash Bros.* and several *Pokémon* games by HAL Laboratory, along with Hudson's *Mario Party* series.

HANDHELD SNAPSHOT: GAME BOY COLOR

The **Game Boy Color** (GBC) (Figure 8.26) was released in the United States on November 18, 1998 for just $79.99. It was the first backward compatible handheld system, able to play all of the original Game Boy games. While the system did not contain a back light or enhanced resolution, it could display up to 56 colors on screen (Table 8.9). Its CPU could run twice as fast and contained three times more RAM than the original Game Boy. It also included a feature that allowed players to create their own color palettes (up to 10 colors) for older, monochrome GB games.

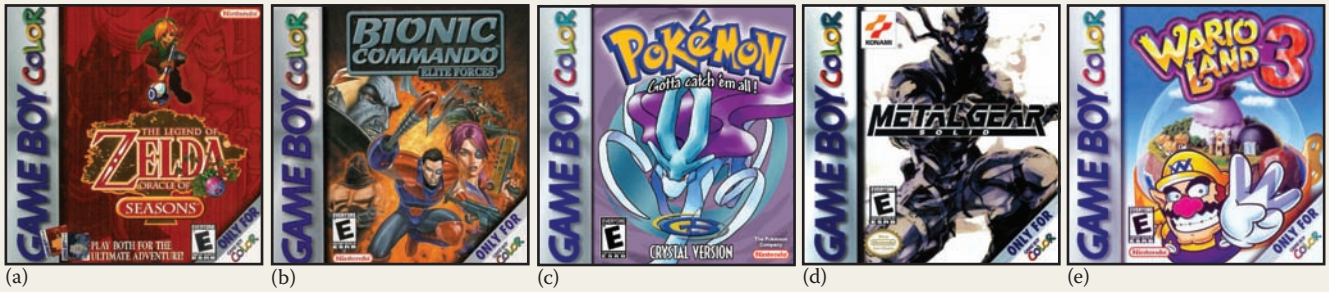
TABLE 8.9 Game Boy Color Tech Specs

Format:	Cartridge/2 AA batteries (20 hours)
Processor:	8-bit Sharp LR35902 CPU (4.194 or 8.338 MHz)
Memory:	32 KB RAM, 16 KB Video RAM
Resolution:	160 × 144 pixels/3.5" diagonal LCD screen
Colors:	10, 32, or 56 from a palette of 32,768 colors
Sound:	4 channel stereo/3.5 mm headphones jack

Well over 500 games were officially released for the GBC, with tens of millions of systems sold. Its strong library of games (see Figure 8.27) totally eclipsed the rest of the portable market, burying Sega's Genesis-based **Nomad**, Tiger's **R-Zone** and **Game.com** handhelds, as well as the **Neo•Geo Pocket**, Bandai's Japan-only **WonderSwan**, and Nintendo's own Virtual Boy.

FIGURE 8.26 Game Boy Color.

FIGURE 8.27 Five defining Game Boy Color titles: (a) *Legend of Zelda: Oracle of Seasons*, (b) *Bionic Commando: Elite Forces*, (c) *Pokémon Crystal*, (d) *Metal Gear Solid*, and (e) *Wario Land 3*.



(a) (b) (c) (d) (e)

■ FIFTH-GENERATION MARKET SUMMARY

Not since the second generation of video games has the market seen so many console releases—many of which never reached American shores (see Figure 8.28). Among those examined in this chapter, 3DO's unique business model may have been its biggest downfall. While the $3 royalty fee for each game sold benefited software manufacturers, it was not high enough to compensate for the high price of the console's manufacturing costs. The small royalties collected also did not provide enough funding for strong marketing (Retro Gamer, 2009, p. 190). Furthermore, having several manufacturers producing the same console essentially put them in competition with each other for the same product, which did not make a lot of sense to either consumers or retailers.

The Atari Jaguar outsold the 3DO initially, but ultimately ended up being a complete market failure, selling only around 250,000 units worldwide. Beyond its architectural complexity, which made it difficult to program games for, everything from the Tramiel family's business choices, to Atari just not being a large enough force anymore to compete have been blamed for the console's demise (Szczepaniak, 2009, p. 200). In its 1995 fiscal year-end report, Atari (1995) attributed the poor performance of Jaguar to extensive delays in game development, consumer concern as to when titles would be made available, and "the introduction of competing products by Sega and Sony in May 1995 and September 1995, respectively" (p. 3). Ultimately, market success in the video game industry usually comes down to great games, and the Jaguar had very few.

In retrospect, "concentrating on Saturn proved to be a tactical mistake that cost Sega millions, if not billions, of dollars at the end of 1995. According to TRST data released in 1997, 32-bit products made up less than 20 percent of 1995 video game sales, while 16-bit sales accounted for approximately 64 percent of the market" (Kent, 2001, p. 531). Following the departure of Kalinske and Rosen, Sega reached out to executive vice president of Sony Computer Entertainment of America, Bernie Stolar, who would become Sega of America's next president and chief operating officer. Stolar did not hesitate to point out "major mistakes [that] had been made by Sega with the Saturn's design and the subsequently fragmented marketing of platforms and sub-platforms" (Fahs, 2009, p. 8). His mission was to discontinue the system as smoothly as possible.

FIGURE 8.28 A look at less-popular fifth-generation consoles released outside of the United States.

Fujitsu FM Town Marty
February 1993 (Japan)

Commodore Amiga CD32
September 1993 (Europe+)

Bandai Playdia
September 1994 (Japan)

NEC PC-FX
December 1994 (Japan)

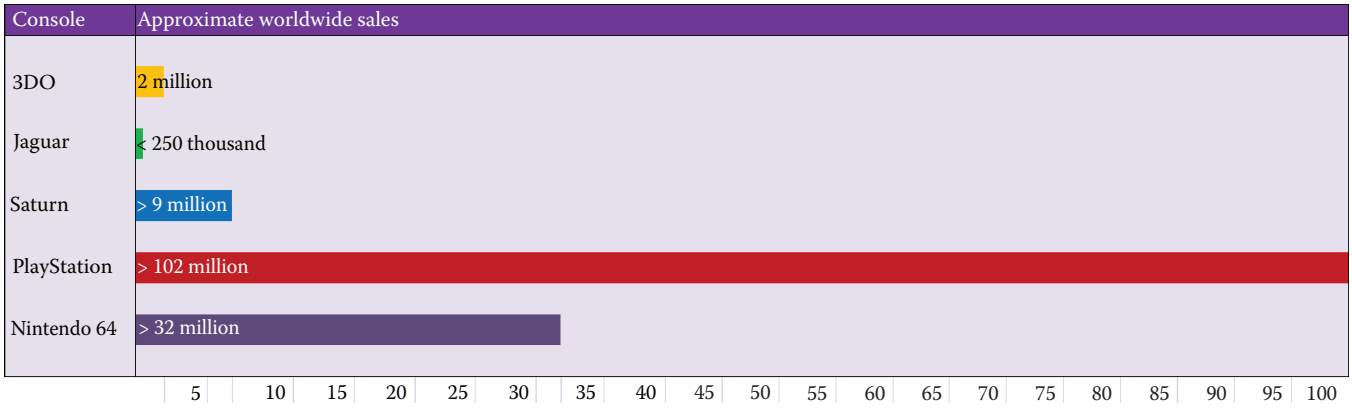
Casio Loopy
October 1995 (Japan)

Apple Bandai Pippin
March 1996 (Japan)

The millions of dollars Sony spent on acquiring developers and on marketing paid off. Within just two days of its launch in North America, the PlayStation sold more units than the Saturn had in the five months following its surprise launch, completely selling out its initial shipment of 100,000 units (Kent 2001, pp. 519–520). Within its first year, the PlayStation secured over 20% of the entire U.S. video game market (Finn, 2002, p. 50). For its first system, Sony's PlayStation completely dominated the industry, eventually making Sony the new leader of the home console market (see Figure 8.29).

The Nintendo 64 was "the top-selling system in America for each of the eight months since its introduction" (Business Wire, 1997). It was most popular in the United States, selling more than 20 million of its 30+ million total units sold. Still, Nintendo found itself in a distant second place to Sony after being a market leader the previous two generations. Much of Nintendo's struggle was likely due to its cartridge format, which led to the loss of Squaresoft, sparse support from Capcom and Namco, and lower number of quality role-playing games. N64 cartridges also typically cost around $10 more than CD games. "By August 1997, Nintendo controlled 40 percent of the next-generation console market and Sony controlled 47 percent, leaving Sega with a mere 12 percent" (Kent, 2001, p. 558).

FIGURE 8.29 Fifth-generation console sales graph.



■ FIFTH-GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the fifth generation of video games. Here is a list of the top 10 features that defined the generation:

1. 32-bit and 64-bit microprocessors
2. Higher display resolution (typically 640 × 480 pixels, i.e., 480i)
3. 3D polygon graphics with texture mapping
4. Optical disc (CD-ROM) game media (leading to "demo disc" marketing)
5. Full motion video (FMV) animation and live action footage
6. CD quality audio (16-bit, 44.1 kHz)
7. Color depth up to 16,777,216 colors (24-bit true color)
8. Texture lighting and Gouraud (continuous, interpolated) shading
9. Graphics smoothening methods such as anti-aliasing and texture filtering
10. Analog stick (touch sensitive) controllers

■ ACTIVITY: FAILED CONSOLES REPORT AND PRESENTATION II

Choose a fifth-generation home console or handheld system that is considered a market failure and develop a report and presentation on the history, business, and technology of that system. Be sure to include: (1) the publisher's goals, (2) how the system was marketed, (3) technical specifications and notable game titles, (4) why the system failed, and (5) [conclusion] what might have saved the console from its demise.

The report should contain three main points and a minimum of *two* quotes which are to be paraphrased or cited verbally in the speech. The recommended total presentation length is 3:30–4:30 minutes, not to exceed 5 minutes total.

CONSOLE SUGGESTIONS

Suggested consoles to report on include: Fujitsu FM Towns Marty (February 1993, Japan),Commodore Amiga CD32 (September 1993, Europe+), Bandai Playdia (September 1994, Japan), NEC PC-FX (December 1994, Japan), Casio Loopy (October 1995, Japan), and Apple Bandai Pippin (March 1996, Japan). You may also consider the Atari Jaguar CD (September 1995); however, that was an add-on peripheral and not a standalone console.

HANDHELD SUGGESTIONS

Suggested handheld systems to report on include: Genesis Nomad (October 1995),R-Zone (1995), Virtual Boy (August 1995), Game.com (September 1997), Neo•Geo Pocket (October 1998, Japan), and WonderSwan (March 1999, Japan).

■ CHAPTER 8 QUIZ

1. Sega's first polygonal racing and fighting arcade games that helped pioneer the genre:
   a. *Hard Drivin'* and *Pit Fighter*
   b. *Ridge Racer* and *Tekken*
   c. *Virtua Racing* and *Virtua Fighter*
   d. *Mario Kart* and *Smash Bros.*

2. The arcade mega complex GameWorks was formed by three companies, except:
   a. Steven Spielberg's Dreamworks
   b. Sega Enterprises
   c. Sony Pictures
   d. Universal Studios

3. Who was *not* directly responsible for creating the 3DO Interactive Multiplayer?
   a. Atari Lynx designer Dave Needle
   b. Atari Lynx designer R. J. Mical
   c. Electronic Arts founder Trip Hawkins.
   d. Panasonic founder Konosuke Matsushita

4. Which of the following was *not* a trait of the 3DO Interactive Multiplayer system?
   a. The first fifth-generation, 32-bit console
   b. Original launch price of $299.99
   c. 3DO did not manufacture its own hardware
   d. No regional copy protection on its games

5. In addition to the 64-bit Jaguar, Atari was initially planning a 32-bit console called:
   a. Leopard
   b. Lynx
   c. Panther
   d. Tiger

6. Which of these reasons have been blamed for Jaguar's sparse third-party support?
   a. Complex, multiple processor architecture
   b. Incomplete developer instructions
   c. Both a and b
   d. None of the above

7. To give North American gamers a 32-bit experience before the U.S. launch of Saturn, Sega introduced an add-on to the Sega Genesis called the:
   a. 32X
   b. Nomad
   c. Power Base Converter
   d. None of the above

8. Due to Saturn's early launch in the United States, which store did not carry the system?
   a. Toys "R" Us
   b. KayBee Toys
   c. Electronics Boutique
   d. Software Etc.

9. Who was the main designer of the Sony PlayStation?
   a. Konosuke Matsushita
   b. Akio Morita
   c. Masaru Ibuka
   d. Ken Kutaragi

10. Which game publisher produced *Final Fantasy VII* as a PlayStation exclusive?
    a. Namco
    b. Squaresoft
    c. Psygnosis
    d. Rareware

11. Prior to launching the N64, Nintendo released a portable, 32-bit table-top console capable of displaying monochrome 3D graphics using red LED technology called:
    a. Game Boy Color
    b. Project Reality
    c. Ultra 32
    d. Virtual Boy

12. Why did Nintendo likely stay with a cartridge format for the N64?
    a. Cartridges were harder to copy/pirate
    b. Faster to boot up/with little to no load times
    c. Production control/profit
    d. All of the above

13. Had exclusive titles NiGHTS into Dreams, Panzer Dragoon Saga, and Guardian Heroes:
    a. 3DO
    b. Saturn
    c. PlayStation
    d. Nintendo 64

14. Which two consoles included internal storage memory for saving game data?
    a. 3DO and Jaguar
    b. Jaguar and Saturn
    c. Saturn and 3DO
    d. PlayStation and Nintendo 64

15. Based its marketing campaign on targeting gamers around the age of 19:
    a. Panasonic REAL 3DO
    b. Sega Saturn
    c. Sony PlayStation
    d. Nintendo 64

16. This console's controllers included 3.5 mm headphones jacks and could also be "daisychained" for multiplayer gaming:
    a. Sega Saturn
    b. Nintendo 64
    c. Sony PlayStation
    d. Panasonic REAL 3DO

17. The only fifth-generation system to only use cartridges as the sole format for its games:
    a. Sega Saturn
    b. Nintendo 64
    c. Sony PlayStation
    d. Panasonic REAL 3DO

18. This system dominated the fifth generation in worldwide console sales:
    a. Panasonic REAL 3DO
    b. Nintendo 64
    c. Sony PlayStation
    d. Atari Jaguar

19. Sega Saturn's demise in the United States was primarily because of:
    a. Entering the fifth-generation market too late
    b. Fragmented marketing of platforms and subplatforms like 32X
    c. Too many product recalls due to bad chip sets
    d. Direct competition from the N64 at its launch

20. This console's "control stick" and force feedback (rumble) pioneered the way future video game controllers would be made:
    a. Panasonic REAL 3DO
    b. Sega Saturn
    c. Sony PlayStation
    d. Nintendo 64

True or False

21. The 3DO used interpolation, a computer algorithm that essentially upscaled its graphics to 640 × 480 resolution.

22. Around 200 games were released for the Atari Jaguar in the United States, with more than 100 additional games that were released exclusively in Japan.

23. With its two Hitachi SH2 32-bit RISC CPUs, the Sega Saturn was the first self-proclaimed 64-bit home console.

24. The PlayStation initially began as a Super Nintendo CD add-on unit that was being developed by Sony.

25. Compared to game cartridges, CD-ROMs are cheaper to manufacture.

■ FIGURES

FIGURE 8.1 Screenshots of defining arcade games from the mid-1990s: (a) *Virtua Racing* (Sega, 1992), (b) *Tekken* (Namco, 1994), and (c) *Area 51* (Mesa Logic/Atari 1995). (*Virtua Racing* courtesy of Sega, 1993; *Tekken* courtesy of Namco, 1994; and *Area 51* courtesy of Mesa Logic/Atari 1995.)

FIGURE 8.2 The Panasonic R•E•A•L 3DO Interactive Multiplayer with standard controller. ("The Panasonic 3DO FZ-1, a video game console released in 1993" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18370417. Retrieved from https://en.wikipedia.org/wiki/3DO_Interactive_Multiplayer#/media/File:3DO-FZ1-Console-Set.jpg)

FIGURE 8.3 Screenshots from early 3DO titles (a) *Crash 'N Burn* and (b) *Total Eclipse*. (*Crash 'N Burn* courtesy of Crystal Dynamics, 1993; and *Total Eclipse* courtesy of Crystal Dynamics, 1993.)

FIGURE 8.4 Typical two-page magazine advertisement for the Panasonic 3DO in 1993. (Retrieved from Electronic Gaming Monthly Issue 53, December 1993, pp. 70-71.)

FIGURE 8.5 Box art to five defining 3DO titles including: (a) *Star Control II*, (b) *Road Rash*, (c) *Gex* (d) *The Need for Speed*, and (e) *Super Street Fighter II Turbo*. (*Star Control II* courtesy of Toys for Bob/Crystal Dynamics, 1993; *Road Rash* courtesy of Monkey Do Productions/Electronic Arts, 1994; Gex courtesy of Crystal Dynamics /BMG Interactive Entertainment, 1994; *Road & Track Presents*: *The Need for Speed* courtesy of Pioneer Productions/Electronic Arts Victor, 1994; and *Super Street Fighter II* Turbo courtesy of Capcom, 1994.)

FIGURE 8.6 Other 3DO Interactive Multiplayer systems, including the redesigned (a) Panasonic FZ-10, (b) GoldStar (LG) model, and (c) the Japan-exclusive Sanyo 3DO TRY. (Left: "*Panasonic FZ-10* R•E•A•L 3DO Interactive Multiplayer" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=36701232. Retrieved from https://en.wikipedia.org/wiki/3DO_Interactive_Multiplayer#/media/File:3DO-FZ-10-Console-FL.jpg. Center: "GoldStar (LG) 3DO Interactive Multiplayer" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=19709831. Retrieved from https://en.wikipedia.org/wiki/3DO_Interactive_Multiplayer#/media/File:3DO-GDO-101M-Console-Set.jpg. Right: "The Sanyo 3DO TRY (Japan only)" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=36699908. Retrieved from https://en.wikipedia.org/wiki/3DO_Interactive_Multiplayer#/media/File:3DO-TRY-Console-FL.jpg)

FIGURE 8.7 Atari Jaguar and a standard controller with its numeric keypad. ("The Atari Jaguar console shown with the standard controller" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=18269034. Retrieved from https://en.wikipedia.org/wiki/Atari_Jaguar#/media/File:Atari-Jaguar-Console-Set.jpg)

FIGURE 8.8 Screenshots from the two Jaguar U.S. launch titles (a) *Cybermorph* and (b) *Trevor McFur in the Crescent Galaxy*. (*Cybermorph* courtesy of Attention To Detail/Atari Corporation, 1993; and *Trevor McFur* in the *Crescent Galaxy* courtesy of Atari Corporation, 1993.)

FIGURE 8.9 Page two of a multipage magazine advertisement for Atari Jaguar in 1994. (Retrieved from *Electronic Gaming Monthly*, Issue 54, January 1994, p. 18)

FIGURE 8.10 Box art to five defining Jaguar titles including: (a) *Alien vs. Predator*, (b) *Wolfenstein 3D*, (c) *Rayman*, (d) *Doom*, and (e) *Tempest 2000*. (*Alien vs. Predator* courtesy of Rebellion/Atari Corporation, 1994; *Wolfenstein 3D* courtesy of id Software/Atari Corporation, 1994; *Rayman* courtesy of Ubisoft, 1995; *Doom* courtesy of id Software/Atari Corporation, 1994; and *Tempest* 2000 courtesy of Llamasoft /Atari Corporation, 1994.)

FIGURE 8.11 The Sega 32X on the top of a Model II Sega Genesis, on top of a Sega CD II. ("Sega-CD II with a Genesis II and a 32X attached. Each device requires its own power supply." by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14303771. Retrieved from https://en.wikipedia.org/wiki/Sega_CD#/media/File:Sega-Genesis-Model-2-Monster-Bare.jpg)

FIGURE 8.12 Sega Saturn with the original U.S./European MK-80100 controller. ("The original NA Sega Saturn" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17351615. Retrieved from https://en.wikipedia.org/wiki/Sega_Saturn#/media/File:Sega-Saturn-Console-Set-Mk1.png)

FIGURE 8.13 Sega Saturn launch titles *Panzer Dragoon* (a) and *Virtua Fighter* (b). (*Panzer Dragoon* courtesy of Team Andromeda/Sega, 1995; and *Virtua Fighter* courtesy of Sega AM2/Sega, 1995.)

FIGURE 8.14 Box art to five popular Saturn titles including: (a) *Shining Force III*, (b) *NiGHTS into Dreams*, (c) *Virtua Fighter 2*, (d) *Panzer Dragoon Saga*, and (e) *Guardian Heroes*. (*Shining Force III* courtesy of Camelot Software Planning/Sega, 1998; *NiGHTS into Dreams* courtesy of Sonic Team/Sega, 1996; *Virtua Fighter 2* courtesy of Sega AM2/Sega, 1996; *Panzer Dragoon Saga* courtesy of Team Andromeda/Sega, 1998; and *Guardian Heroes* courtesy of Treasure/Sega, 1996.)

FIGURE 8.15 Magazine advertisement for the Sega Saturn in 1996. *GamePro: The Cutting Edge*, Spring 1996, p. 47. IDG Publishing. (From *GamePro*: The Cutting Edge, Spring 1996, p. 47.)

FIGURE 8.16 The Sony PlayStation video game console with original d-pad controller. ("The original PlayStation. "The very first PlayStation model, the Japanese SCPH-1000, shown with original controller and memory card" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=31719221. Retrieved from https://en.wikipedia.org/wiki/PlayStation_models#/media/File:PlayStation-SCPH-1000-with-Controller.jpg)

FIGURE 8.17 Screenshots from PS launch titles (a) *Battle Arena Toshinden* and (b) *Ridge Racer*. (*Ridge Racer* courtesy of Namco/SCEA, 1995; and *Battle Arena Toshinden* courtesy of Tamsoft /SCEA, 1995.)

FIGURE 8.18 1995 PlayStation magazine ad featuring Sofia from *Battle Arena Toshinden*. (From *GamePro* 74, September 1995, p. 101. IDG Publishing.)

FIGURE 8.19 The smaller "PSone" with matching DualShock controller and memory card. ("A PSone game console shown with matching controller and memory card" by Evan-Amos - own work, CC BY-SA 3.0. Available t https://commons.wikimedia.org/w/index.php?curid=17670847. Retrieved from https://en.wikipedia.org/wiki/PlayStation_(console)#/media/File:PSone-Console-Set-NoLCD.jpg)

FIGURE 8.20 Box art to five defining PlayStation titles including: (a) *Resident Evil*, (b) *Final Fantasy VII*, (c) *Tomb Raider*, (d) *Metal Gear Solid*, and (e) *Tekken 3*. (*Resident Evil* courtesy of Capcom, 1996; Final Fantasy VII courtesy of SquareSoft/SCEA, 1997; Tomb Raider courtesy of Core Design Ltd./Eidos Interactive, 1996; Metal Gear Solid courtesy of KCEJ/Konami, 1998; and Tekken 3 courtesy of Namco, 1998.)

FIGURE 8.21 Virtual Boy. ("A North American Virtual Boy game console, made by Nintendo" by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=19135757. Retrieved from https://en.wikipedia.org/wiki/Virtual_Boy#/media/File:Virtual-Boy-Set.jpg)

FIGURE 8.22 The Nintendo 64 with its unique, three-handle controller. ("The Nintendo 64, a fifth generation gaming console released by Nintendo in 1996, over a year later than its rivals the Sega Saturn and Sony PlayStation" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=36531250. Retrieved from https://en.wikipedia.org/wiki/Nintendo_64#/media/File:Nintendo-64-wController-L.jpg)

FIGURE 8.23 Screenshots from N64 U.S. launch titles (a) *Super Mario 64* and (b) *Pilotwings 64*. (Courtesy of Nintendo, 1996.)

FIGURE 8.24 Magazine advertisement for the Nintendo 64 gaming console from 1996. (From GamePro 91 April, 1996, p. 15. IDG Publishing.)

FIGURE 8.25 Box art to five defining Nintendo 64 titles: (a) *The Legend of Zelda: Ocarina of Time*, (b) *Perfect Dark*, (c) *Super Mario 64*, (d) *Goldeneye 007*, and (e) *Banjo-Kazooie*. (The *Legend of Zelda*: Ocarina of Time courtesy of Nintendo, 1998; Perfect Dark courtesy of Rare Ltd./Nintendo, 2000; *Super Mario 64* courtesy of Nintendo, 1996; *Goldeneye 007* courtesy of Rare Ltd./Nintendo, 1997; and *Banjo-Kazooie* courtesy of Rare Ltd./Nintendo, 1998.)

FIGURE 8.26 Game Boy Color. ("The Game Boy Color, a handheld gaming console released by Nintendo in 1998" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=38957124 Retrieved from https://en.wikipedia.org/wiki/Game_Boy_Color#/media/File:Nintendo-Game-Boy-Color-FL.jpg)

FIGURE 8.27 Five defining Game Boy Color titles: (a) Legend of Zelda: Oracle of Seasons, (b) Bionic Commando: Elite Forces, (c) Pokémon Crystal Version, (d) Metal Gear Solid, and (e) Wario Land 3. (*Legend of Zelda*: *Oracle of Seasons* courtesy of Flagship/Nintendo, 2001; *Bionic Commando*: Elite Forces courtesy of Nintendo Software Technology/Nintendo, 2000; *Pokémon* Crystal Version courtesy of Game Freak/Nintendo, 2001; *Metal Gear Solid* courtesy of TOSE/Konami, 2000; and *Wario Land 3* courtesy of Nintendo, 2000.)

FIGURE 8.28 A look at less-popular fifth-generation consoles released outside of the United States. ("An FM Towns Marty video game console, released only in Japan by Fujitsu" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=17385778. Retrieved from https://en.wikipedia.org/wiki/FM_Towns_Marty#/media/File:FM-Towns-Marty-Console-Set.png. "The Amiga CD32, a 32-bit, CD-ROM based video game console from Commodore, with one controller" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=33879250. Retrieved from https://en.wikipedia.org/wiki/Amiga_CD32#/media/File:Amiga-CD32-wController-L.jpg. "The PC-FX, a fifth-generation gaming console by NEC" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34653886. Retrieved from https://en.wikipedia.org/wiki/PC-FX#/media/File:NEC-PC-FX-wController-R.jpg. "The Japanese Bandai Pippin (Atmark Player) and wireless controller" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18341966. Retrieved from https://en.wikipedia.org/wiki/Apple_Bandai_Pippin#/media/File:Pippin-Atmark-Console-Set.jpg. "The Bandai Playdia, a video game console that was only released in Japan" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=34696628. Retrieved from https://en.wikipedia.org/wiki/Playdia#/media/File:Bandai-Playdia-Set-R.jpg. "The Casio Loopy, a 1995 video game console only released in Japan that was marketed to girls and could print stickers" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18341210. Retrieved from https://en.wikipedia.org/wiki/Casio_Loopy#/media/File:Casio-Loopy-Console-Set.png)

FIGURE 8.29 Fifth-generation console sales graph. (Designed by Wardyga using data from Resource Site for Video Game Research, "Console Wars through the Generations" http://dh101.humanities.ucla.edu/DH101Fall12Lab4/graph—console-wars and GamePro. "The 10 Worst-Selling Consoles of All Time." Retrieved from http://www.gamepro.com/gamepro/domestic/games/features/111822.shtml and Consoles +, issue 73. Retrieved from http://i.imgur.com/wQPBhdL.jpg)

Pro File: Trip Hawkins. Photo by Christopher Michel. https://www.flickr.com/photos/cmichel67/18972740201/, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=41635723. Retrieved from https://commons.wikimedia.org/wiki/File:Trip_Hawkins_(18972740201).jpg#/media/File:Trip_Hawkins_(18972740201).jpg.

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Video Games Become Big Business

OBJECTIVES

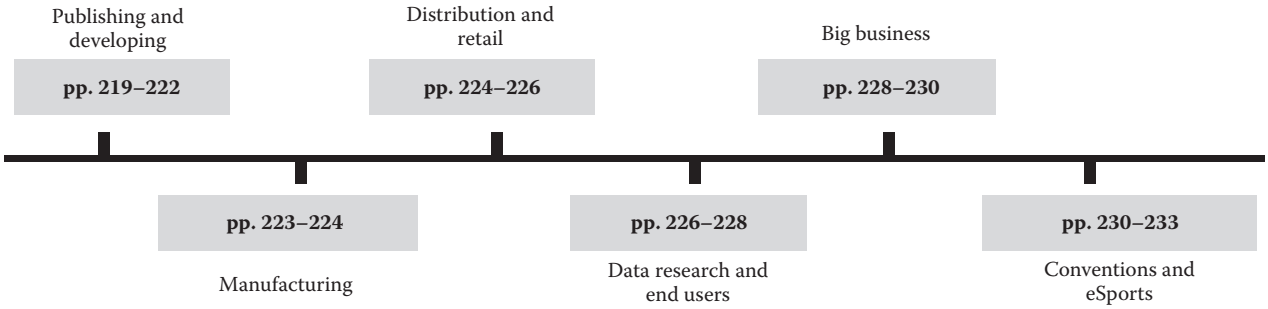
After reading this chapter, you should be able to:

- Summarize the process and traditional value chain of producing a video game.
- Describe the common milestones in a video game development cycle.
- Define the major roles and job positions in a video game development studio.
- Understand the basics of how a video game is made.
- Discuss well-known market rush problems with both consoles and software.
- Be familiar with types of intellectual properties and licensed video games.
- Describe sales curves and compare physical and digital distribution methods.
- Summarize some of the top publishers and best-selling video game franchises.
- Reflect on market trends using data from the NPD Group and other services.
- Explain video game bugs and patches and why they have become more common.
- Discuss major video game conventions such as CES, E3, and PAX Prime.
- Provide a summary of eSports and its rapid growth in recent years.

■ KEY TERMS AND PEOPLE

Alpha stage
Analytics
Artificial intelligence
Artist
Battle.Net World Championship Series
Beta stage
BlizzCon
Bugs
Tom Cannon
Capital and publishing layer
Circuits
Code freeze stage
Code release
Community Management
Consumer Electronics Show (CES)
Crowdfunding
Crunch time
Cyberathlete
Designer
Developer
Sundance Digiovanni
Digital distribution
Distribution layer
Distributor
Downloadable content (DLC)
DreamHack
Eco-Box
EEDAR
Electronic Arts (EA)
Electronic Entertainment Expo (E3)
Electronic Sports League (ESL)
End User
Enterbrain
Entertainment Software Association (ESA) eSports
Evolution Championship Series (EVO)
Expansion packs
First playable stage
First-party developer
Flurry Analytics
Franchise
Freemium
Free-To-Play (F2P)
Game engine
Gamestop
Gartner
Gold Master stage
Hardware layer
Indie fund
In-House developer
Intel Extreme Masters
Intellectual property
Interactive Software Federation of Europe
Jewel case
Kickstarter
Korean e-Sports Association (KeSPA)
LAN party
League of Legends
Level designer
Licenses/licensing
Localization
Longbox
Doug Lowenstein
Jarid Lukin
Major League Gaming Inc. (MLG)
Manufacturer
Massively Multiplayer Online (MMO)
Microtransactions
Milestones
MineCon
Monetization
Multiplayer Online Battle Arena (MOBA)
Newzoo
NPD Group, Inc.
Open world game
Packaging line
Patch
Pay-To-Win (P2W)
Penny Arcade Expo (PAX Prime)
PlayStation Store
Polycarbonates
Keep case/Poly-box
Pro gaming
Product and talent layer
Production and tools layer
Programmer
Publisher
QuakeCon
Quality assurance
Red Ring of Death
Retailer
Royalty fees
Ben Sawyer
Second-party developer
Mike Sepso
Sound engineer
Steam
Studio
SuperData Research
Tester
The Gathering
The International
Third-party developer
Turtle Entertainment
Twitch
User Interface (UI)
Value chain
Valve
VGChartz
Brett Walton
World Cyber Games (WCG)
Xbox Games Store

■ CHAPTER OUTLINE



■ INTRODUCTION

The video game industry is also known as the "interactive entertainment industry." As the economic sector responsible for the development, marketing, and sales of video games, it encompasses dozens of job disciplines and employs thousands of professionals from across the globe (Zackariasson and Wilson, 2012). This chapter elaborates on the people and process of making a video game, including the many hurdles and considerations that must be made along the way. Gamer demographics, top publishers, and best-selling video game franchises will be examined—in addition to major video game events such as E3, eSports, and other video game attractions.

■ GAME INDUSTRY VALUE CHAIN

At the FuturePlay 2009 conference, **Ben Sawyer** of Digitalmill described the **value chain** (set of processes) of the video game industry as consisting of six connected layers. These six layers include: (1) Capital and Publishing, (2) Product and Talent, (3) Production and Tools, (4) Distribution, (5) Hardware, and (6) End-users (Sawyer, 2009). Each of these layers is discussed within the "value chain" sections presented in this chapter. For instance, the capital and publishing layer is discussed in the next two sections about development funding and publishing priorities. The product and talent layer, as well as the production and tools layer are discussed in the section on development—on so on.

Traditionally, the process begins with either the **publisher** seeking a developer to create a game the publisher is interested in funding. Sometimes the **developer** may seek out a publisher to fund a game the developer is interested in creating, as seen in Figure 9.1. Once the game is completed, the physical cartridge or disc (along with its case and often instruction manual) is produced in volume by the **manufacturer**. The **distributor** then delivers the game to **retailers**, who stock their stores to sell the game to consumers—referred to as **end users**. The following sections will examine each of these participants in detail.

■ FUNDING

Video game publishers are responsible for the capital, marketing, legal, and licensing aspects of a video game production. A major part of this **capital and publishing layer** includes the process of funding of the game—which today can cost tens of millions of dollars for a single big-budget title. Traditional ways publishers fund the development of a game is through **milestones** (development stages). A milestone schedule is drawn up during the negotiation phase of a publishing agreement which outlines the milestones the developer must meet to continue receiving revenue advances from the publisher (Victory Media, 2014, p. 16). Since milestones vary depending on the publisher and project, there is no industry standard for defining them. There are however, many common milestones for video game development as illustrated in Table 9.1.

While not exactly a milestone, **crunch time** is the name of the overtime phase that can happen before any of the above milestones when development is behind schedule. During crunch time, workers put in many extra (often unpaid) hours to bring the project up to speed. These extra hours are typically reimbursed with additional (sometimes paid) time-off, which is granted after the milestone is reached or when the game is completed.

A less-traditional but growing means of financing the development of a video game is through **crowdfunding** (fundraising through Internet donations on websites like **Kickstarter** and other collection methods). This method of raising money for game development is one way developers can sidestep a publisher who may be unwilling to invest in a game they see as too niche or risky for traditional funding. Developer "Double Fine's Tim Schafer shattered Kickstarter records when his campaign for *Broken Age*—previously known as *Double Fine*

FIGURE 9.1 Traditional value chain of the video game industry.

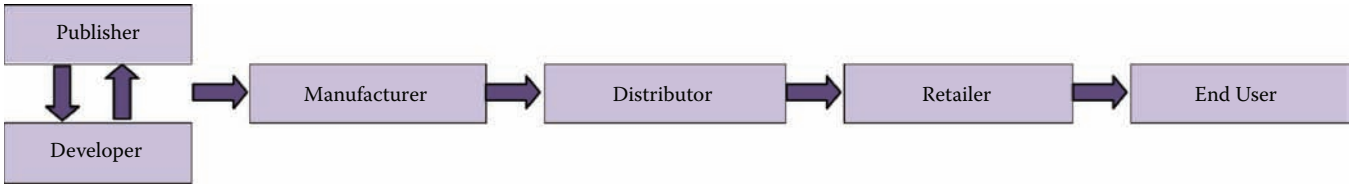


TABLE 9.1 Common Milestones in a Video Game Development Cycle	
First playable	The first functional version of the game. First playable and Alpha can refer to a single milestone in smaller projects (Bethke, 2003, p. 293).
Alpha	By this phase, all fundamental gameplay is functioning, and major game features are finalized.
Code freeze	At the code freeze stage, no new code is added. Here developers are largely working on debugging the game.
Beta	The game appears complete and should contain no evident bugs. No changes are made to the game features, assets, or code (Chandler 2009, p. 245).
Code release	Final bugs are fixed and game is ready to be shipped or reviewed by the manufacturer and tested for quality assurance.
Gold master	The final game's build that is used as the master version for production of the game (Bethke 2003, p. 295).

Adventure—raised $3.3 million. Like *Broken Sword*, *Broken Age* is a point-and-click adventure game, a niche genre not typically backed by major publishers" (Hiscott, 2014, para. 10).

■ PUBLISHING

Beyond financing development, other publisher functions include paying for **localization** (adapting the game's text, symbols, and language for other cultures), as well as covering design, layout, and printing costs (of box art and/or instruction manuals) for physical releases. It is also common practice for publishers to pay **royalty fees** for physically manufactured games. Unlike most industries where royalties are paid on actual sales of a product, video game publishers typically pay royalty fees upfront at the time of manufacturing. This adds an obvious risk, where the publisher (not the manufacturer) absorbs the loss for any games that are unsold.

Another consideration of publishing includes whether any party will be seeking returns through **licensing** the title—granting permission to use certain logos, characters, and/or other **intellectual properties** (IPs). Intellectual property rights are the legally recognized exclusive rights to intangible assets, such as musical scores, video game characters, words, phrases, symbols, and other game design attributes. Often, a game series or character is part of a *franchised* IP. "A **franchise** is the licensing of intellectual property from an original work, to other parties or partners for commercial exploitation" (Victory Media, 2014, p. 20). Once all legal rights and copyrights have been attained, the next step for the publisher is to market the game. Today, publishers can spend more on marketing than on the actual development of a big-budget title. The returns on such investments can be significant, with the highest grossing video game companies earning billions of dollars (Figure 9.2).

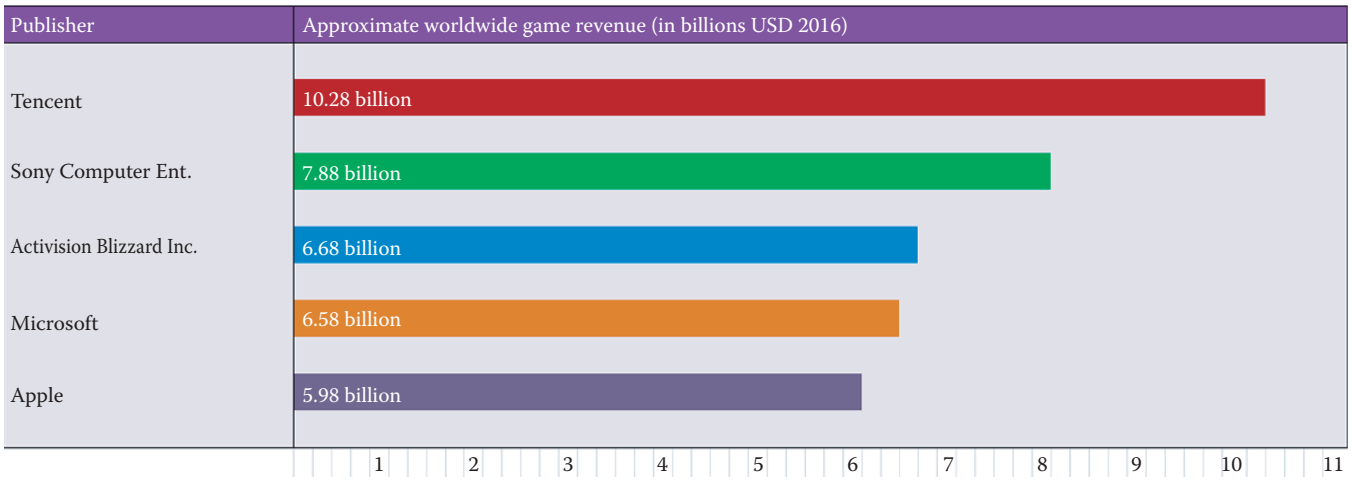
DID YOU KNOW?

Nintendo holds the record for some of the best-selling video game franchises of all time. Among these franchises are *Mario, Pokémon*, and *Wii Sports* (Gammon, 2015, p. 2).

■ DEVELOPMENT

The **developer** includes the **product and talent layer** of writers, producers, designers, programmers, artists, animators, and other talent responsible for the design phase of the game. See Table 9.2 for some of the most influential video game developers. These professionals work under individual contracts or as part of in-house development teams, and often under one roof called a **studio**. "Studios are mostly local companies with staffs from a handful of persons up to several hundred, depending on the types of games developed and progress of the company" (Zackariasson and Wilson, 2014, p. 3). Development studios can be found all over the world, with some of the largest development markets coming

FIGURE 9.2 Top five highest grossing video game companies by game revenue.



from the United States, Japan, and Canada, respectively (Rudden, 2010).

There are three main types of developers: third-party, in-house, and independent. **Third-party developers** are external teams who provide outsourced work for publishers. **In-house developers** (also called **first-party developers**) are owned by the publisher and commonly share a building or campus with them. **Independent developers** are the smallest—usually consisting of one person to a small group of people. Like third-party developers, they are not owned by a publisher and usually publish their games themselves. Because they do not operate under the constraints of publisher demands, independent developers typically have the most creative freedom of the three.

DID YOU KNOW?

The term **second-party developer** is sometimes used for an independent studio or subsidiary developer who accepts a development contract from a publisher or platform holder like Sony, Nintendo, or Microsoft.

Typically, three **licenses** must be obtained before a developer begins work on a game: (1) a license to develop the game for a specific console, (2) a license to publish the game for the console (obtained by the publisher), and (3) a license for the specific game to be developed. This falls under Sawyer's **hardware (or virtual machine/software platform) layer**. Will the game be PC or console-based, or multiplatform—and on which

TABLE 9.2 Ten of the Most Influential Video Game Developers

	Developer	Founded	Key Game Series
10	id Software	1990	Doom, Quake, Wolfenstein 3D
9	Maxis	1987	The Sims, SimCity, Spore
8	Blizzard Ent.	1991	World of Warcraft, Diablo, StarCraft
7	Valve	1996	Half-Life, Portal, Left 4 Dead
6	Squaresoft	1986	Final Fantasy, Chrono Trigger, Xenogears
5	Atari	1972	Asteroids, Gauntlet, Centipede
4	Konami	1969	Metal Gear Solid, Castlevania, Silent Hill
3	Rockstar North	2002	Grand Theft Auto, Manhunt
2	Capcom	1983	Street Fighter, Devil May Cry, Resident Evil, Mega Man
1	Nintendo	1889	Super Mario Bros., The Legend of Zelda, Metroid

console(s)? Will content for the game be accessible online, or available on mobile devices? This layer now includes network infrastructure and non-hardware platforms such as virtual machines (e.g., Java or Flash), or software platforms such as browsers or even further Facebook, and so on (Sawyer, 2009). Sometimes a game is designed for a specific platform and later **ported** (translated/reprogrammed) to another system. There are even development companies whose specific function is porting titles to different platforms.

This leads to the **production and tools layer,** which involves the programming phase of the game. This layer involves the creation of content production tools, as well as customizable game engines and production management tools for developers to work with. A **game engine** (such as RenderWare, Unity, and Unreal) provides many prebuilt, reusable game components that the developer can use to build a game more efficiently. The components may include "loading, displaying, and animating models, collision detection between objects, physics, input, graphical **user interfaces [UI]**, and even portions of a game's **artificial intelligence [AI]**" (Ward, 2008, para. 4). Testing, debugging, and localization may also fall under this layer of development.

Table 9.3 lists some common roles of a video game development team. The many roles of a developer continue to expand as the video game market changes and becomes more of an online medium. New roles of the developer in the digital age now include analytics, monetization, and community management (Llamas, 2014, p. 23). With **analytics**, developers collect and analyze data about players to create a more custom-tailored experience for them. **Monetization** includes the various methods of collecting returns on a game, which includes but is not limited to: (1) retail sales of physical copies, (2) digital downloads, and (3) in-game **microtransactions** (additional game content that can be bought after the initial purchase of the game—such as new costumes, weapons, characters, maps, etc.). **Community management** includes maintaining relations with a game's community players, strategic planning, customer service, and execution and reporting of all community activity.

Many of these roles also exist under the publisher—further blurring the lines of responsibility as the market evolves. As the traditional value chain dissolves, developers may find themselves with more leverage than ever before. For example, "developers who self-fund a game, either through investors, crowdfunding or partnerships like **Indie Fund**, can publish their games on [a console or other device] without having to fork over their IP or sign an exclusivity agreement, says Adam Boyes, Sony's VP of developer and publisher relations" (Hiscott, 2014, para. 18). Because of the massive amount of work that goes into games today, many development studios consist of hundreds of employees.

TABLE 9.3 Common Roles of a Video Game Development Team

Designer	Designs the gameplay, rules, and structure of a game; may also work on the game's narrative (Moore and Novak, 2010, pp. 74, 94).
Artist	Often overseen by an **art director** or **art lead**, responsible for conceptual designs and/or the actual game graphics.
Programmer	The **software engineer** who works on the game's codebase, including but not limited to: physics, AI, graphics, sound, gameplay, scripting, UI, input processing, network communications, and other game tools.
Level Designer	The level designer creates the game's stages, maps, and environments.
Sound Engineer	Responsible for sound effects and sound positioning; may oversee voice acting and other sound asset creation (Moore and Novak, 2010, p. 91).
Tester	Extensively analyzes the game for bugs; provides quality assurance that the game both works and is entertaining (Bates, 2004, p. 177).

■ MANUFACTURING

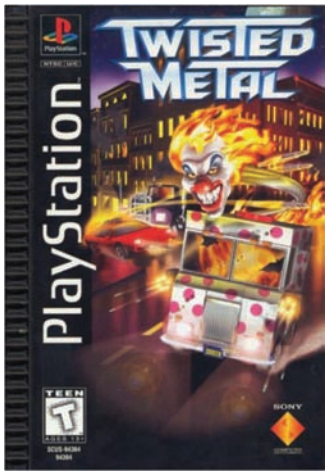
Console **manufacturers** consist of the platform holders such as Sony, Nintendo, and Microsoft and the production of their consoles and video games takes place in **manufacturing plants**. Many raw materials are needed to manufacture video games, including plastics such as **polycarbonates** and aluminum to create today's optical discs. Even more materials are required to produce the intricate **circuits** of a cartridge. There is also the plastic, paper, and ink needed to produce the **keep case** (also called a **poly-box**) and instruction manual. Once manufactured, the game's components are transported to the **packaging line** where the game is placed in its protective case, conveyored to a shrink-wrap machine, and boxed for shipment (Romanowski, 2006, para. 18).

Because of the cost and resources required to produce a game, manufacturers have been working toward reducing the amount of materials needed to make them. Early cost-saving changes in the game industry included the shift from cartridge-based games to optical disc games. Keep cases have also gotten smaller and lighter over the years. A prime example of this is when Sony changed its initial "**longbox**" keep case to the CD-style **jewel case** for all of its PlayStation games in 1996 (Figure 9.3). In 2010, Ubisoft declared they would no longer be including a physical instruction manual with their games. Sony and Electronic Arts, among others, have followed suit and this trend is growing thanks to digital manuals that can be downloaded from the games, as well as in-game tutorials.

In late 2009, Hong Kong-based case manufacturer **Viva Group** introduced a more economically and environmentally friendly keep case called the **'Eco-Box'** (shown in Figure 9.4). This lighter, hollow keep case was first adopted by Microsoft for the Xbox 360 and Nintendo for the Wii. The cases use around 20% less plastic compared to traditional keep cases and significantly reduce CO_2 production emissions. "Kyle Sheppard, Manager of Business Development at Viva […] says this initiative to reduce packaging was actually driven by retailers and not game publishers" (Reilly, 2009, para. 3), however, publishers are seeing small savings from the cases.

Manufacturing has not been without its flaws. Over the years there have been several well-documented instances of video game products being pushed to manufacturing before they met acceptable **quality assurance (QA)** standards. The initial shipment of Nintendo Famicoms had to be recalled due to a bad chip set (Kent, 2001, p. 279). Years later, consumers complained about their original Sony PlayStation overheating, which would often lead to video and sound skipping during full motion video sequences. A 2009 *Game Informer* survey estimated that more than **54%** of every Microsoft Xbox 360 suffered from hardware failure (p. 12). Commonly referred to as the "**Red Ring of Death**," systems that encountered internal problems would display flashing red lights around the console's power button, indicating the console would need servicing. Ever since consoles have been able to connect to the Internet, the market has seen a dramatic increase in the number of games that are shipped with **bugs** (glitches and other problems)

FIGURE 9.3 *Twisted Metal* (1995) original "longbox" versus the smaller jewel case packaging.

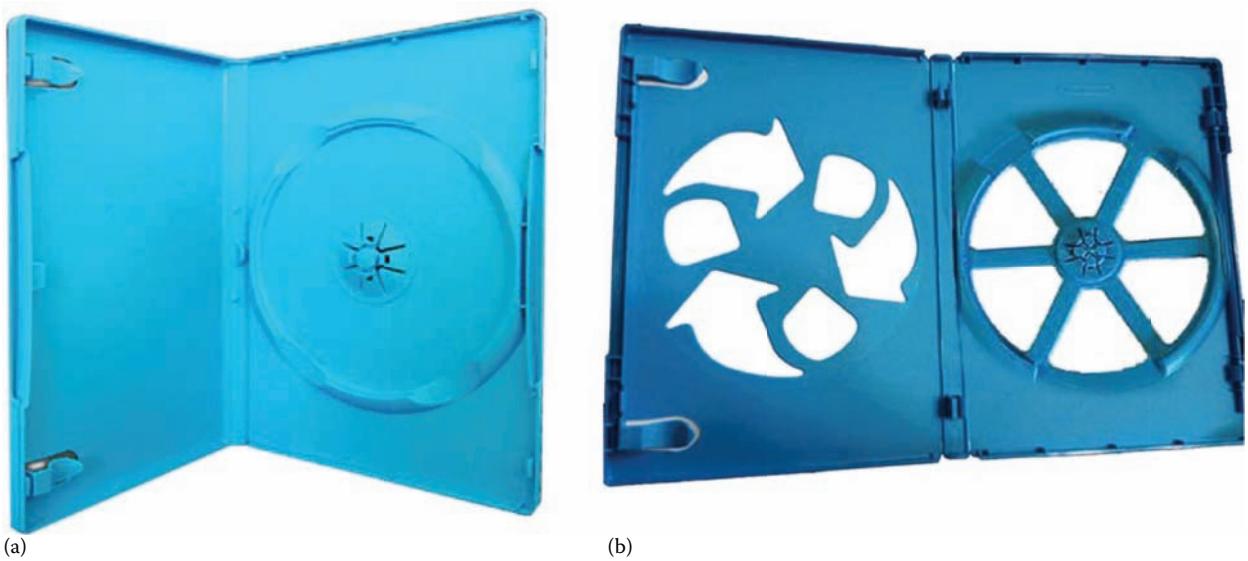


Original "longbox"

Jewel case version

Game disc for context

FIGURE 9.4 Traditional keep case (a) versus "Eco-Box" as shown for Wii U games (b).



(a) (b)

that often require a downloadable **patch** (software update). Bugs have turned up in a variety of games, but seem to be most common in large **open world** games, where there is more room for something to be missed by game testers.

■ DISTRIBUTION

The **distribution layer** is the true "publishing" part of the process, which involves generating and marketing catalogs of games for retail and online distribution (Sawyer, 2009). Large video game publishers typically distribute the games themselves, while smaller publishers often hire an independent distribution company to deliver the games to retailers. Such external distributors serve as the middleman between the publisher and retailer, adding yet another cost onto the publishing layer. This cost is being cut in recent generations with a reduction in physical distribution from the steady growth of instant home delivery known as **digital distribution**.

With faster broadband and greater hard drive space, digital, downloadable versions of games are becoming more popular than ever. Sony's **PlayStation Store** and Microsoft's **Xbox Games Store** (formerly Xbox Live

FIGURE 9.5 Digital and retail console game trends, seventh and eighth generation (EEDAR, 2015).

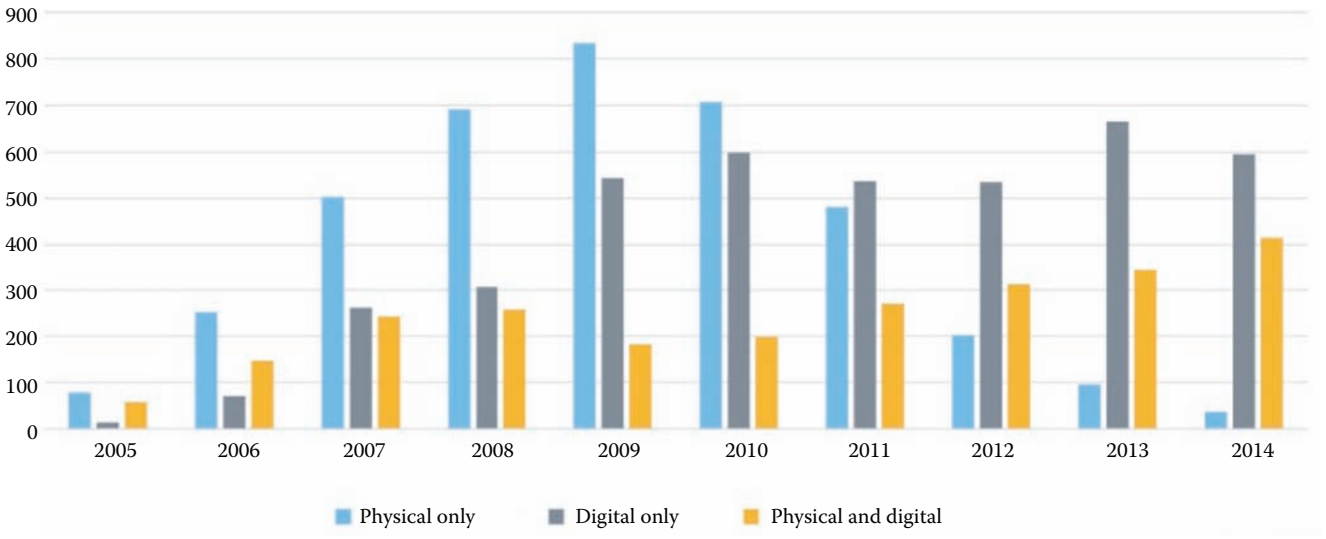
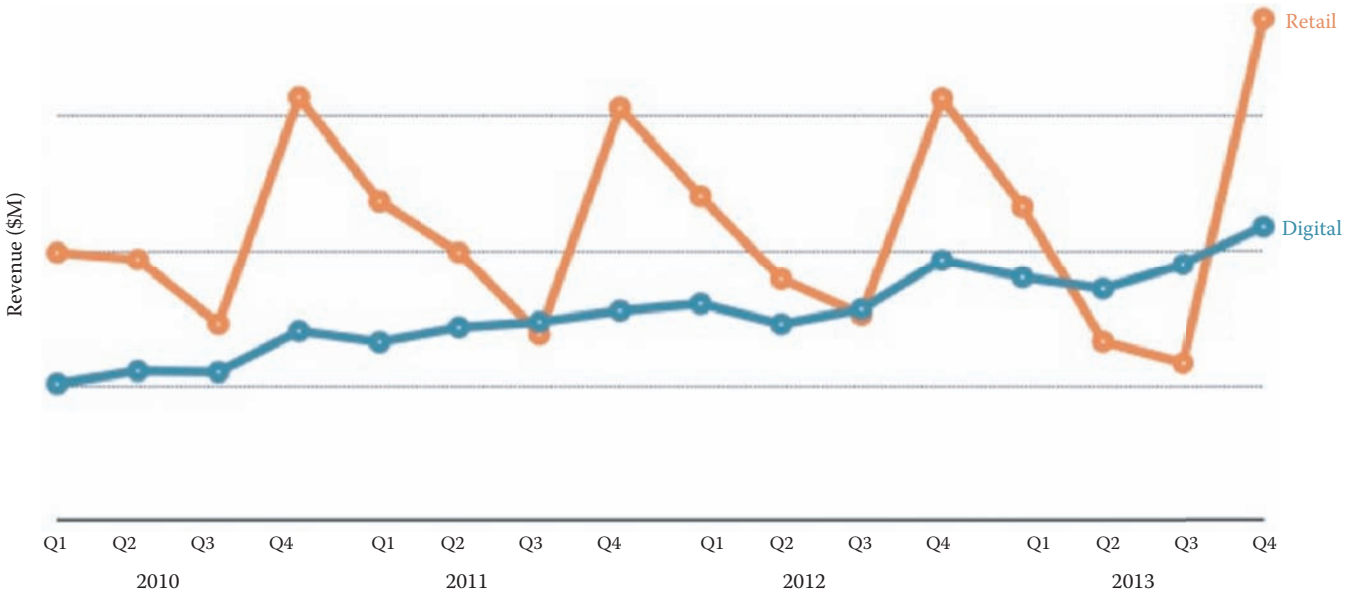


FIGURE 9.6 Growth of digital sales and retail holiday spikes (SuperData Research, 2014).



Marketplace) are setting new standards for online distribution, where users can purchase and instantly download digital versions of games on their consoles. "Third-party companies are also providing the possibilities of buying games online. The company **Valve**, for example, has developed a software package called **Steam** where customers can download games directly to their PC" (Zackariasson and Wilson, 2014, p. 4). **Digital downloads** are the future of video games (see Figure 9.5), since they save tremendous publishing costs. With digital downloads, there is no middleman distributor, no physical game, box, or instruction manual to manufacture, and no retail shelves to stock.

■ RETAIL

One member of the value chain who may not be as enthusiastic about video games shifting to the digital download market is the brick and mortar **retailer**. Traditional retailer roles include providing shelf space for games, initiating customer loyalty programs, and offerings such as preorder bonuses for customers who put a deposit down on a game to reserve a copy before it is released. As Figure 9.6 shows, digital sales have been on a slow but steady rise, however, it is the retail outlets that see the largest spikes between the third and fourth quarters when a large portion of video games are released for the holiday season.

Retailers might also argue that "how a game is packaged does still matter: its cover, instructional folders and additional content. As a physical product, this combination is what meets the customer's eye at a retailer. The importance of shelf space thus continues to be important because of the visibility importance to the consumer and its attraction power" (Zackariasson and Wilson, 2014, p. 4). To maintain this retail visibility as games make the shift to digital, retailers like **GameStop** have begun selling digital download codes for games since signing a deal with Blizzard back in 2012. *Diablo III* was the first game sold through download codes in the stores (Crecente, 2012). Will such new strategies be enough for brick and mortar retailers to survive the trend toward digital distribution (Figure 9.7)?

FIGURE 9.7 Digital distribution chain: Is this the future value chain for all video games?

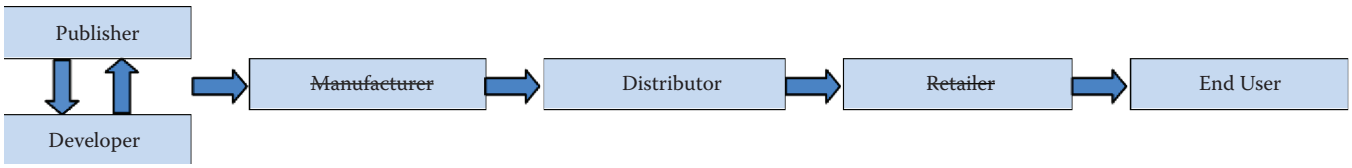
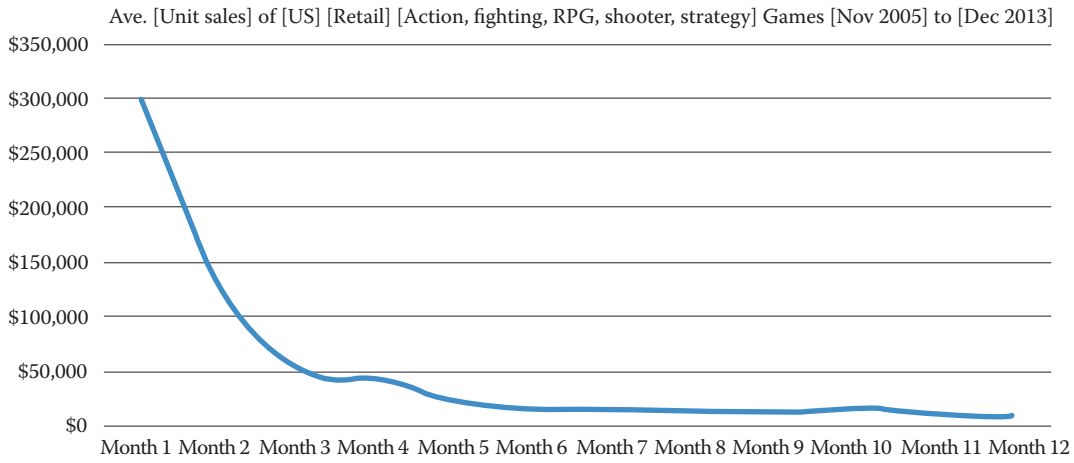


FIGURE 9.8 PlayStation and Xbox 12-month game sales curve (EEDAR and NPD, 2015).



Whatever the format, retailers often have a very short window to sell new releases. As Figure 9.8 indicates, most new video game sales typically occur within the first 2 ½ months of a game's retail debut, leveling off after about 5 months on the market. Since the highest volume of sales happens within the first month, it's no wonder publishers and developers work so hard to meet each game's publicized release date.

■ DATA RESEARCH

There are many research organizations that track the sales and trends of video games. The **NPD Group, Inc.** (formerly National Purchase Diary) began its retail tracking service for toys in 1984. It is now a global company that monitors consumer purchase data from over 165,000 stores. The **Entertainment Software Association** (**ESA**, formerly the Interactive Digital Software Association) was founded by **Doug Lowenstein** in 1994. The ESA "conducts business and consumer research, and provides analysis and advocacy on issues like global content protection, intellectual property, technology, e-commerce and the First Amendment in support of interactive software publishers" (ESA, 2015, p. 16).

VGChartz is a video game sales tracking website launched in 2005 by **Brett Walton**. The website provides weekly sales figures of both console software and hardware by region (North America, Europe, Japan, and globally). See Table 9.4 for console sales figures. **Electronic Entertainment Design and Research (EEDAR)** was founded in 2006 by a team of interactive software veterans. Their focus is specifically on video game industry market research, such as sales data, industry trends, market predictions, and review score forecasts, among other services. **SuperData Research, Inc.** was founded in 2009 by veteran games industry researchers. The group provides market intelligence on free-to-play and digital games, as well as key trends, revenue estimates, and market change analysis for all major types of video game platforms. Other leading video game market intelligence providers include **Newzoo**, **Gartner**, and **Flurry Analytics**.

■ END-USERS

"End-users" is the industry term for the consumers who play video games. They make up the final layer of the video game value chain and are the lifeblood of the industry. Whether they purchase the games themselves or receive their games as gifts, their desire to play the latest, cutting edge games is what keeps the industry moving forward. So, who are these "end-users" that play video games? According to recent Entertainment Software Association (ESA) reports, 42% of Americans play at least three hours of video games per week. Among this gamer population, approximately 56% are male and 44% female (ESA, 2015, pp. 3–4). These numbers are fairly consistent around the world, with Japanese publisher **Enterbrain** and the **Interactive Software Federation of Europe (ISFE)** showing very similar numbers for Japan and Europe.

The average age of today's gamer is around **35 years old**. The gaming population's age breakdown is roughly one third under 18 years old, one third between 18 and

TABLE 9.4 Total Worldwide Sales (millions of units) per Platform (VGChartz, 2017)

Pos	Platform	N. America	Europe	Japan	Other	Total
1	PlayStation 2 (PS2)	53.65	55.28	23.18	25.57	157.68
2	Nintendo DS (DS)	57.39	52.07	33.01	12.43	154.90
3	Game Boy (GB)	43.18	40.05	32.47	2.99	118.69
4	PlayStation (PS)	38.94	36.91	19.36	9.04	104.25
5	Wii (Wii)	45.51	33.88	12.77	9.48	101.64
6	PlayStation 3 (PS3)	29.42	34.55	10.47	12.46	86.90
7	Xbox 360 (X360)	49.11	25.87	1.66	9.16	85.80
8	Game Boy Advance (GBA)	40.39	21.31	16.96	2.85	81.51
9	PlayStation Portable (PSP)	21.41	24.14	20.01	15.26	80.82
10	PlayStation 4 (PS4)	25.04	29.22	5.81	13.05	73.12
11	Nintendo 3DS (3DS)	22.88	19.57	23.79	3.96	70.20
12	Nintendo Entertainment System	33.49	8.30	19.35	0.77	61.91
13	Super Nintendo Ent. System	22.88	8.15	17.17	0.90	49.10
14	Xbox One (XOne)	22.10	9.83	0.09	4.12	36.14
15	Nintendo 64 (N64)	20.11	6.35	5.54	0.93	32.93
16	Sega Genesis (GEN)	16.98	8.39	3.58	0.59	29.54
17	Atari 2600 (2600)	23.54	3.35	0.00	0.75	27.64
18	Xbox (XB)	15.77	7.17	0.53	1.18	24.65
19	GameCube (GC)	12.55	4.44	4.04	0.71	21.74
20	PlayStation Vita(PSV)	2.55	5.22	5.70	2.39	15.86
21	Wii U (WiiU)	6.23	3.54	3.33	0.87	13.97
22	Nintendo Switch (NS)	5.11	2.94	3.19	0.97	12.19
23	GameGear (GG)	5.40	3.23	1.78	0.21	10.62
24	Atari 7800 (7800)	1.83	1.12	5.80	0.07	8.82
25	Dreamcast (DC)	3.90	1.91	2.25	0.17	8.20

35 years old, and one third over 35 years old (ESA, 2015, p. 3). These figures indicate that gamers continue with their hobby well into their adult years, and longitudinal data shows that the average age of gamers is on the rise.

Also on the rise is mobile, casual, and social gaming, which is leading to market growth in regions such as China, MENA (Middle East and North Africa), and South America. As for the *types* of games played, the numbers on home console and PC couldn't be further apart. NPD data shown in Table 9.5 suggests that console gamers favor action games, shooters and sports, and are more likely to try other genres of games. PC gamers, on the other hand, are mostly interested in strategy games, casual, and role-playing games—which make up more than 82% of the best-selling games on personal computers.

Best-selling titles for each platform further reflect the differences between console and PC gaming (Tables 9.6 and 9.7). The top console games often come from a variety of publishers, while the best-selling PC titles tend to be dominated by a small number of large publishers. Taking a look at the top 10 best-selling PC games of 2014, the entire list is dominated by Electronic Arts, Blizzard Entertainment, and Bethesda Softworks—and many of these entries are only **expansion packs** (add-on levels, quests, storylines, etc.) to existing games.

TABLE 9.5 Best-Selling Video Game Genres by Units Sold (NPD, 2016)

	Action	Casual	Shooter	Sports	Strategy	RPG	Other
Console	22.9%	0.9%	24.5%	13.2%	3.8%	11.6%	23.1%
PC	4.1%	25.8%	6.3%	0.2%	36.4%	18.7%	8.5%

TABLE 9.6 Top 10 Best-Selling Console Games of 2015 (NPD, 2016)

Rank	Title	Publisher	Platform(s)
1	Call of Duty: Black Ops III	Activision	Xbox One, PS4, 360, PS3, PC
2	Madden NFL 16	EA Sports	PS4, Xbox One, 360, PS3
3	Fallout 4	Bethesda	PS4, Xbox One, PC
4	Star Wars: Battlefront	Electronic Arts	Xbox One, PS4, PC
5	Grand Theft Auto V	Rockstar Games	PS4, Xbox One, 360, PS3, PC
6	NBA 2K16	2K Sports	PS4, Xbox One, 360, PS3
7	Minecraft	Various	360, Xbox One, PS3, PS4
8	FIFA 16	EA Sports	PS4, Xbox One, 360, PS3
9	Mortal Kombat X	Warner Bros.	PS4, Xbox One
10	Call of Duty: Advanced Warfare	Activision	Xbox One, PS4, 360, PS3, PC

■ BIG BUSINESS

Since 2007 the video game industry has been outperforming box office and music sales in overall returns. While that may be comparing apples to oranges, video games have become big business with total worldwide hardware and software sales in 2015 exceeding $91 billion (Sinclair, 2015, para. 1). Growth is predicted in just about every video game market in the world over the next several years. The **average cost** of a new video game in the 1990s was $50. That price rose to $60 during the seventh generation of gaming in the 2000s. Of course, it takes a lot more people and money to make a blockbuster title compared to earlier generations, and inflation cannot be left out of the equation. Figure 9.9 paints a picture of how a video game's earnings are distributed.

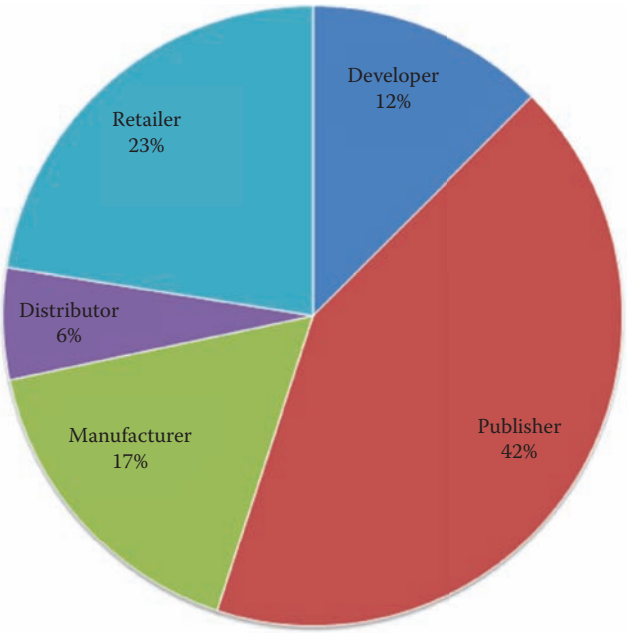
The following estimates are based off data from Alex Pham of *The Los Angeles Times* (2010), *Unreality Magazine* (2011), and Director of Research and Consumer Insights Stephanie Llamas at SuperData Research (2014).

Business	Earnings	Percent
Developer	$6–$9	approx. 12%
Publisher	$24–$27	approx. 42%
Manufacturer	$7–$12	approx. 17%
Distributor	$3–$4	approx. 6%
Retailer	$12–$15	approx. 23%

TABLE 9.7 Top 10 Best-Selling PC Games of 2014 (NPD, 2015)

Rank	Title	Publisher	ESRB
1	The Sims 4	Electronic Arts	Teen
2	The Sims 3: Starter Pack	Electronic Arts	Teen
3	Diablo III: Reaper of Souls	Bethesda	Mature
4	The Elder Scrolls Online	Electronic Arts	Mature
5	World of Warcraft: Warlords of Draenor Expansion Pack	Blizzard Ent.	Teen
6	Diablo III	Blizzard Ent. and Square Enix	Mature
7	Titanfall	Electronic Arts	Mature
8	The Sims 3: Island Paradise Expansion Pack	Electronic Arts	Teen
9	The Sims 3: Seasons Expansion Pack	Electronic Arts	Teen
10	Elder Scrolls V: Skyrim	Bethesda	Mature

FIGURE 9.9 Estimated dollar distribution of an end-user's $60 retail video game purchase.



One of today's big trends in gaming is inventing ways for the consumer to invest more money into a game, beyond the initial purchase price via **downloadable content (DLC)**. The concept of selling new campaigns with expansion packs (a long time PC practice) began making its way onto consoles through online gaming. Once gamers were wired to the Internet, a whole new form of revenue was born through digital downloads. The most common "extra" purchases in games today are called **microtransactions**. Microtransactions are virtual goods that can be purchased by the player to enhance their gaming experience. They can be simple aesthetic items, such as retro uniforms for a sports team, to game-changing items like super powerful armor and weaponry.

Controversy has developed in many gaming communities in games where players can purchase virtual goods to level up their character and gain an advantage over other players—especially if the purchased items cannot be acquired by non-monetary means. The derogatory phrase **"pay-to-win" (P2W)** has been commonly used by gamers to describe these types of microtransactions. This practice has led to an entirely new video game business model where games marketed as **"free-to-play" (F2P)** can actually end up costing gamers who are willing to pay to progress after investing a reasonable amount of time in a game. This has become a common source of revenue in mobile games as Table 9.8 illustrates.

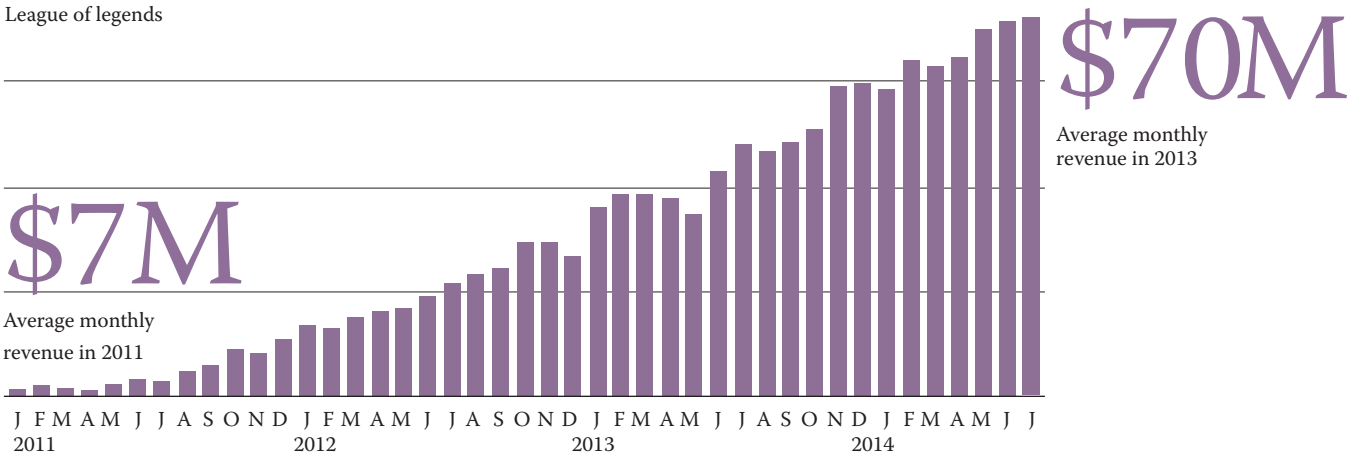
This strategy of offering a game free to play, only to charge players for certain features or functionality was coined as **"freemium"** by **Jarid Lukin** in 2006 (Schenck, 2011, para. 2). It has been the primary model for successful mobile games like *Clash of Clans, Game of War*, and *Candy Crush Saga*. Other successful free-to-play models have been with **massively multiplayer online (MMO)** games like *World of Warcraft* and the **multiplayer online battle arena (MOBA)** game *League of Legends* (Figure 9.10).

The free-to-play or freemium model may be most popular in mobile and PC gaming; however, the amount of dollars spent on microtransactions by console owners continues to rise. Stephanie Llamas of SuperData Research, Inc. provides information on the types of microtransactions that console gamers are spending their money on. According to Llamas (2014), 55% of spenders purchase weapons or weapon upgrades, 36% spend money on vanity items, 33% on vehicles or upgrades, 32% on expansion packs, 26% on map packs, 26% on songs, 19% on class unlocks, and 10% on side stories (p. 68). There are also many games (as well as consoles) that require a **monthly fee** to play—adding to

TABLE 9.8 Top Grossing "Free-To-Play" Mobile Games by Revenue (Super Data, 2017)

Rank	Title	Publisher
1	Honor of Kings	Tencent Games (China)
2	Fantasy Westward Journey	NetEase (China)
3	Lineage M	NCSoft (South Korea)
4	Clash of Clans	Supercell (Finland)
5	Pokémon GO	Niantic, Inc. (San Francisco)

FIGURE 9.10 Revenue from "free-to-play" MOBA *League of Legends* (SuperData, 2014).



the hundreds of dollars spent upfront to purchase the console.

■ VIDEO GAME CONVENTIONS

Conventions where game publishers can showcase their latest titles and technology have always been an important part of the video game business. The first major convention to display the latest in gaming technology was the **Consumer Electronics Show (CES)** (Figure 9.11a). Debuting in New York City in 1967 by the Consumer Technology Association (formerly Consumer Electronics Association [CEA]), CES was a showcase of all the latest electronic technology—TVs, sound systems, appliances, and eventually video games. From 1978 to 1994, CES held both a winter (January) show in Las Vegas and a summer (June) show in Chicago. While CES certainly brought positive exposure to the video game business, veterans like former Sega of America CEO Tom Kalinske felt that video games weren't always given the same treatment as other industries—often delegated floor space in the far back of the building or in some cases, in an outdoor tent (Dring, 2013).

Tired of competing for CES floor space with other electronics industries and "with the creation of the

FIGURE 9.11 A spectacle of lights, displays, and people: CES 2012 (a) and E3 2011 (b).

(a)

(b)

Interactive Digital Software Association (IDSA) [now the ESA], the video game industry had its own trade organization and was large enough and prosperous enough to run its own show" (Kent, 2001, p. 503). The **Electronic Entertainment Expo (E3)** held its first video game industry-only convention May 11–13, 1995 at the Los Angeles Convention Center (GamePro, 1995, p. 211). Rumored to have attracted over 50,000 attendees, E3 (seen in Figure 9.11b) quickly became one of the largest conferences in the word for video game publishers and manufacturers to market upcoming games and video game-related merchandise. It remained closed to the public, however, until 2017.

With access to E3 originally being limited to individuals with a professional connection to the video game industry, the **Penny Arcade Expo (PAX Prime)** was launched in 2004 in Bellevue, Washington and became the largest public video game convention in North America. The main conference quickly grew to being held twice a year with "PAX West" held annually in Seattle and "PAX East" in Boston since 2010. More recent conferences have been introduced in Melbourne, Australia ("PAX Australia") since 2013 and "PAX South" in San Antonio, Texas since 2015. Similar to E3, PAX offers attendants hands-on exhibits of upcoming titles, video game presentations, and other entertainment. Further notable video game conventions are listed in Table 9.9.

In addition to the industry-wide conventions, many publishers, developers and gamers have created their own regular gaming events. Some popular conventions from publishers and developers include **BlizzCon**, for Blizzard Entertainment to promote their major franchises, **QuakeCon** by ZeniMax Media, which celebrates and promotes the games of developer id Software, and **MineCon** for the video game *Minecraft*—hosted by developer Mojang. Gamers across the world have come together to create **LAN parties** where systems are linked over a local area network for a shared gaming experience. Norway's **The Gathering** and Sweden's **DreamHack** (shown in Figure 9.12) are some of the largest festivals of this type—many of which have been paving the way for major video game tournaments, now commonly referred to as **eSports**.

■ eSPORTS

eSports (electronic sports) is the term used for professional competitive video gaming, also known as "**pro gaming**." Unlike most other sports which are predominantly athletic-based, eSports are facilitated by electronic means—screens and monitors, consoles and computers, controllers and keyboards. "In more practical terms, eSports commonly refer to competitive (pro and amateur) video gaming that is often coordinated by different leagues, ladders and tournaments, and where players customarily belong to teams or other 'sporting' organizations who are sponsored by various business organizations" (Hamari, 2015, p. 2). The most popular eSports games include real-time strategy games like *StarCraft*,

TABLE 9.9 Notable Video Game Conventions Around the World

Convention	Recent Location	Inaugurated
Consumer Electronics Show (CES)	Las Vegas, NV	1967
Game Developers Conference (GDC)	Various	1988
Electronic Entertainment Expo (E3)	Los Angeles, CA	1995
Tokyo Game Show (TGS)	Chiba, Japan	1996
Asia Game Show (AGS)	Hong Kong, China	2002
Penny Arcade Expo (PAX Prime)	Various	2004
ChinaJoy	Shanghai, China	2004
IgroMir	Moscow, Russia	2006
Dubai World Game Expo (DWGE)	Dubai, UAE	2007
Brasil Game Show (BGS)	São Paulo, Brazil	2009
Gamescom	Cologne, Germany	2009
EB Games Expo	Sydney, Australia	2011

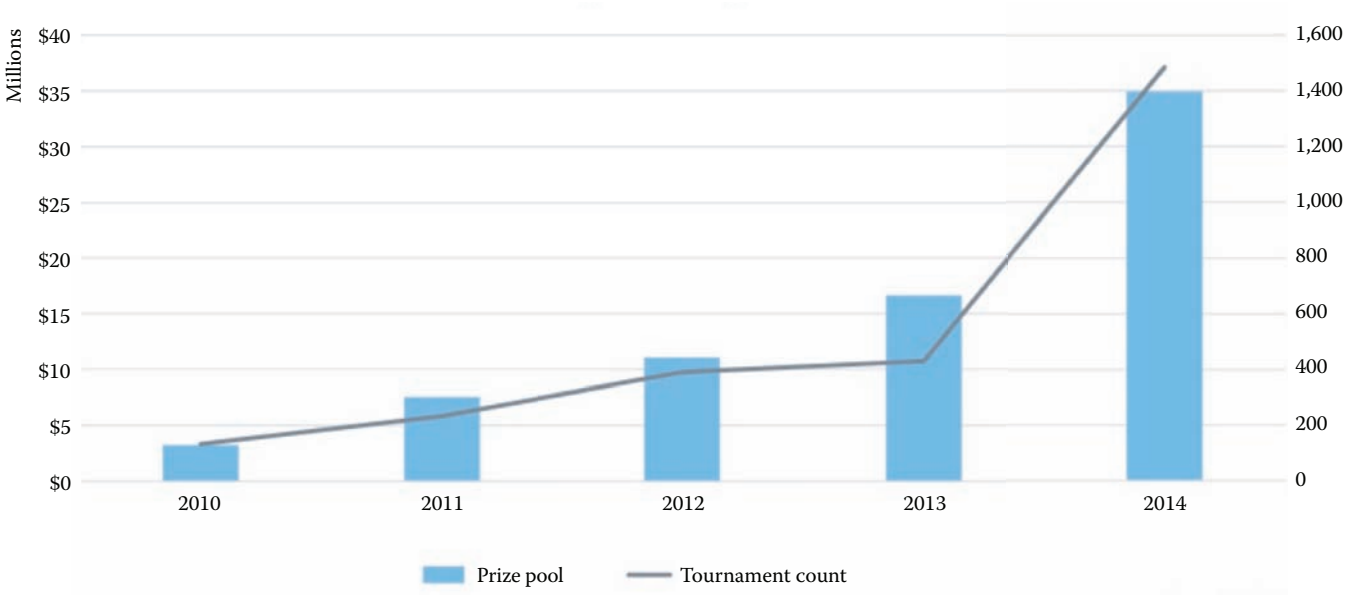
FIGURE 9.12 Winter 2004 DreamHack LAN party and eSports at The International 2014.

first-person shooters (FPS) like *Call of Duty*, multiplayer online battle arena (MOBA) games such as *League of Legends*, and fighting games like the *Street Fighter* series.

Video game tournaments have existed since the earliest days of gaming; however, it wasn't seen as a lucrative profession for top gamers until the early 2000s with the help of **World Cyber Games (WCG)** and the **Korean e-Sports Association (KeSPA)** in South Korea. Founded in 2000, KeSPA was created by South Korea's Ministry of Culture, Sports and Tourism to promote and regulate eSports as a big-ticket industry for their country. Teams wear uniforms similar to NASCAR racers, bearing the logos of South Korean sponsors such as CJ Entus, KT Rolster, Samsung Galaxy, and SK Telecom T1. As the leagues gained popularity, many of the top players have gained celebrity status, selling out large arenas and stadiums. Today, eSports is growing rapidly across the globe, with prize pools literally doubling from 2013 to 2014 according to 2015 EEDAR reports (Figure 9.13).

One of the first major tournaments focused exclusively on fighting games was the **Evolution Championship Series (EVO)**. EVO (formerly Battle by the Bay) was started by **Tom Cannon** in 1996 as a *Super Street Fighter II Turbo* and *Street Fighter Alpha 2* tournament. In 1997, the **Electronic Sports League** (**ESL**, formerly ESPL) was established by **Turtle Entertainment** in Cologne, Germany. The ESL has held **Intel Extreme Masters (IEM)** tournaments around the world for games such as

FIGURE 9.13 Worldwide eSports prize pool and tournament growth (EEDAR, 2015).



Starcraft II, Counter-Strike: Global Offensive, Quake Live, League of Legends, and *Hearthstone: Heroes of Warcraft*. Today it has more than 6,100,000 registered members and consists of over 1,000,000 teams, which have played over 12.1 million games (ESL, 2016).

Other eSports organizations include **Major League Gaming Inc. (MLG)**, which was founded in 2002 by **Sundance DiGiovanni** and **Mike Sepso** and acquired by Activision Blizzard in 2016. Notable eSports organizations headed by major publishers and developers include **The International** (hosted by Valve since 2011), the **League of Legends World Championship** (held by Riot Games), and the **Battle.net World Championship Series** (hosted by Blizzard Entertainment). Like eSports in South Korea, many of these organizations provide live broadcasts of the competition, in addition to the large pools of prize money and salaries for its competitors.

Credit for the explosive growth of eSports can be given to the developers behind the games, the organizations supporting the business, the players (or **cyberathletes**), and of course the fans. The emergence of live streaming webcasts has greatly contributed to the growth of eSports and may be the most common method of watching tournaments. SuperData Research estimates that the average eSports fan spends an average of 2.2 hours viewing an eSports session 19 times per month (Llamas, 2014, p. 55). Online streaming platform **Twitch** (launched in 2011) routinely streams popular eSports competitions. In 2013, "45 million users watched 12 billion minutes of video on Twitch from six million total videos broadcast. That's over a 100 percent increase in each of those metrics from 2012, when 20 million users watched six billion minutes from three million broadcasts" (O'Neill, 2014, para. 3).

■ SUMMARY

There have been a number of major changes in the video game industry over the years. Video games were once designed and programmed by one to a small handful of people on a moderate budget. Today's blockbuster titles are built from teams of hundreds of people, costing tens of millions of dollars. Funding for video game development once dominated by wealthy publishers is now being challenged with crowdfunding initiatives like Kickstarter and partnerships like Indie Fund. The role of video game developers is expanding from just creating a game, to being responsible for data analytics, monetization, as well as community management.

The format of games has been changing from cartridges and floppy disks, to CD, DVD, Blu-ray and other optical media (with smaller and/or flimsier keep cases)—to digital downloads that require no manufacturing or material costs at all. With the growth of digital downloads, the traditional video game value chain is shrinking—often eliminating the manufacturing and retail components of delivering games to end users. Online, mobile, and social gaming now commonly adopt the free-to-play model, hoping players will pay later on to unlock levels, power up their characters, and so forth.

Video game conferences were once only for professionals in the business. Today, conventions like PAX Prime offer consumers access to the latest news and exhibits of upcoming video game releases. Video game tournaments have been around since the beginning of gaming; however, skilled players can now earn a healthy salary with success in eSports. The industry is growing and evolving in many ways. It will certainly be interesting to see where it all goes from here.

DID YOU KNOW?

Many scholars and journalists have begun to theorize that the video game industry has entered a renaissance period—revisiting what made the classic games successful and attempting to incorporate many of those elements into modern titles.

■ ACTIVITY: INTO THE FUTURE

The video game industry is constantly evolving. Here is an opportunity to share your predictions on where the business is headed in the next 20 years.

GUIDELINES

Write a 1,000- to 1,500-word essay on the future of the video game industry. Be sure to cover each area of the traditional video game value chain including publishing, development, manufacturing, distribution, retail, and the end users that play the games.

QUESTIONS

1. Will publishers continue to dish out tens of millions of dollars on triple A titles?
2. Will "indie" ever become mainstream?
3. Do you foresee any new methods of video game funding taking off?
4. Will brick and mortar retailers still exist or will gaming go "all digital?"
5. What about used games? Will digital rights management end used game sales?
6. Will end users even still be playing games on consoles and/or computers?
7. What about virtual reality? Will this technology replace gaming on monitors?
8. What other predictions do you have on how video games will change?

■ CHAPTER 9 QUIZ

1. Which of the following was *not* part of Ben Sawyer's video game industry value chain?
   a. Capital and Publishing
   b. Product and Talent
   c. Brainstorming and Negotiation
   d. Production and Tools

2. The traditional value chain of the video game industry begins with the:
   a. Publisher or Developer
   b. Manufacturer
   c. Distributor
   d. Retailer

3. Traditional ways publishers fund the development of a game is through:
   a. Keystones
   b. Coldstones
   c. Milestones
   d. Publishers never fund the development of a game

4. By this development phase, the game appears complete and should contain no evident bugs. No changes are made to the game features, assets, or code.
   a. First Playable
   b. Alpha
   c. Code Freeze
   d. Beta

5. At this development phase, no new code is added. Here developers are largely working on debugging the game.
   a. First Playable
   b. Alpha
   c. Code Freeze
   d. Beta

6. The licensing of an IP from an original work, to other parties for commercial exploitation:
   a. Crowdfunding
   b. Royalty fee
   c. Localization
   d. Franchise

7. In-house developers that are owned by the publisher and commonly share a building or campus are also known as:
   a. First-party developers
   b. Second-party developers
   c. Third-party developers
   d. Independent developers

8. Which of the following licenses is *not* commonly obtained before a developer begins work on a game?
   a. A license to develop the game for a specific console
   b. A license to develop a game for a specific country
   c. A license to publish the game for the console (obtained by the publisher)
   d. A license for the specific game to be developed

9. This video game development team member plans the gameplay, rules, and structure of a game; may also work on the game's narrative:
   a. Designer
   b. Artist
   c. Programmer
   d. Level Designer

10. Monetization includes the following methods of collecting returns on a game, *except*:
    a. New retail sales of physical copies
    b. Used (pre-owned) game sales data
    c. Digital downloads
    d. In-game microtransactions

11. The rush to release games to the market sometimes results in games with bugs. Once a bug is found, developers often release a software update called a _____ to alleviate the problem.
    a. band-aid
    b. repair kit
    c. gold master
    d. patch

12. Traditional roles of a brick and mortar retailer include:
    a. Providing shelf space for games
    b. Customer loyalty programs
    c. Product offerings such as preorder bonuses
    d. All of the above

13. Estimated dollar distribution of a $60 retail video game purchase shows the largest percentage of revenue goes to the:
    a. Developer
    b. Publisher
    c. Manufacturer
    d. Retailer

14. These types of games can actually end up costing gamers who are willing to pay money to progress after investing a reasonable amount of time in a game:
    a. Pay-to-win (P2W)
    b. Free-to-play (F2P)
    c. Freemium
    d. All of the above

15. This video game console had the highest total worldwide sales as of 2016:
    a. PlayStation 2 (PS2)
    b. PlayStation (PS)
    c. Wii (Wii)
    d. Xbox 360 (X360)

16. The first major convention to display the latest in gaming technology was the:
    a. Consumer Electronics Show (CES)
    b. Electronic Entertainment Expo (E3)
    c. Penny Arcade Expo (PAX Prime)
    d. Tokyo Game Show (TGS)

True or False

17. Publishing costs are being cut with a reduction in physical distribution from the steady growth of instant home delivery known as *digital distribution*.

18. Founded by Doug Lowenstein, the ESA stands for "Electronics Sales Assessment."

19. "Front-users" is the industry term for the consumers who play video games.

20. eSports (electronic sports) is the term used for professional competitive video gaming, also known as "pro gaming."

■ FIGURES

FIGURE 9.1 Traditional value chain of the video game industry. (Courtesy of Wardyga.)

FIGURE 9.2 Top five highest grossing video game companies by game revenue. (From Takashi, D., 2017, March 23. Tencent leads the top 25 public game companies with $10.2 billion in revenues. Retrieved from https://venturebeat.com/2017/03/23/tencent-leads-the-top-25-public-game-companies-with-10-2-billion-in-revenues/)

FIGURE 9.3 *Twisted Metal* (SingleTrac, 1995) original "longbox" versus the smaller jewel case packaging.

FIGURE 9.4 Traditional keep case (a) versus "Eco-Box" as shown for Wii U games (b).

FIGURE 9.5 Digital and retail console game trends, seventh and eighth generation (EEDAR, 2015). (Published on Jun 7, 2015 from the Game Developers Conference. PowerPoint slides by Geoffrey Zatkin. EEDAR PC F2P Report. "Retail Console Games Over Time" p. 66. Retrieved from http://www.slideshare.net/AleixRisco/gdc2015-awesome-video-game-data)

FIGURE 9.6 Growth of digital sales and retail holiday spikes (SuperData Research, 2014). (Stephanie Llamas of Super Data for Digital Games. "Digital vs. retail revenues from quarterly filings and estimates for: Activision, EA, Ubisoft, Take-Two, Square Enix, Konami, Capcom, Disney, THQ." p. 24. Published on Aug 18, 2014. Retrieved from http://www.slideshare.net/StephanieLlamas/gdc-europe-super-data-for-digital-games)

FIGURE 9.7 Could this become the future value chain for digital video games? by Wardyga.

FIGURE 9.8 PlayStation and Xbox 12-month game sales curve (EEDAR and NPD, 2015). (Published on Jun 7, 2015 from the Game Developers Conference. PowerPoint slides by Geoffrey Zatkin. EEDAR PC F2P Report. "Sales Curve: All PlayStation and Xbox Games." p. 52. Retrieved from http://www.slideshare.net/AleixRisco/gdc2015-awesome-video-game-data).

FIGURE 9.9 Estimated dollar distribution of an end-user's $60 retail video game purchase. (*Unreality Magazine*, 2011. How your $60 video game is chopped up. Editorial. Retrieved from http://unrealitymag.com/video-games/how-your-60-video-game-is-chopped-up/ and from FeedVibe http://feedvibe.com/2011/videogame-revenue-split/ and Pham, A. (2010, February 19). Anatomy of a $60 video game. Retrieved from http://latimesblogs.latimes.com/entertainmentnewsbuzz/2010/02/anatomy-of-a-60-dollar-video-game.html)

FIGURE 9.10 Revenue from "free-to-play" MOBA *League of Legends* (SuperData, 2014). (Stephanie Llamas of Super Data for Digital Games. "Free-to-play MMOs: League of Legends." p. 42. Published on Aug 18, 2014. Retrieved from http://www.slideshare.net/StephanieLlamas/gdc-europe-super-data-for-digital-games)

FIGURE 9.11 A spectacle of lights, displays, and people: CES 2012 (a) and E3 2011 (b). (CES 2012 central hall floor photo 2012 Pop Culture Geek taken by Doug Kline. January 10, 2012. CC BY 2.0. Available at http://creativecommons.org/licenses/by/2.0, via Wikimedia Commons "https://commons.wikimedia.org/wiki/File%3ACES_2012_central_hall_floor_(6764012529).jpg". The Community - Pop Culture Geek from Los Angeles, CA, USA. E3 2011 - the South Hall floor photo 2011 PopCultureGeek.com taken by Doug Kline. June 8, 2011. E3 2011 - the South Hall floor https://commons.wikimedia.org/wiki/File:E3_2011_-_the_South_Hall_floor_(5831111978).jpg. The Conmunity - Pop Culture Geek from Los Angeles, CA, USA.)

FIGURE 9.12 Winter 2004 DreamHack LAN party and eSports at The International 2014. ("Winter 2004 DreamHack LAN Party" July 24, 2009, by en:User:Toffelginkgo. CC BY-SA 3.0, Retrieved from https://commons.wikimedia.org/w/index.php?curid=7380926. "The stage and crowd at KeyArena for The International," July 18, 2014, 72157645379601078 by Jakob Wells. Retrieved from https://www.flickr.com/photos/jakobwells/14516251507/in/set-)

FIGURE 9.13 Worldwide eSports prize pool and tournament growth (EEDAR, 2015). (Published on Jun 7, 2015 from the Game Developers Conference. PowerPoint slides by Geoffrey Zatkin. EEDAR PC F2P Report. "eSports Tournaments: eSports Prize Pool And Tournaments." p. 100. Retrieved from http://www.slideshare.net/AleixRisco/gdc2015-awesome-video-game-data)

Title page image: Tokyo_Game_Show_2004_2 by No machine-readable author provided. Calton assumed (based on copyright claims). No machine-readable source provided. Own work assumed (based on copyright claims), CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=311928.

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TABLE 9.8 Total worldwide sales (in millions of units) per platform (VGChartz, 2017). Retrieved from http://www.vgchartz.com/analysis/platform_totals/.

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The Sixth Generation

OBJECTIVES

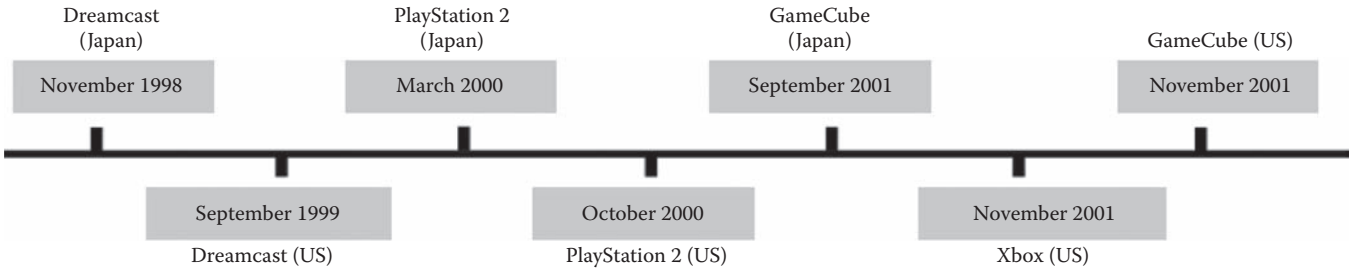
After reading this chapter, you should be able to:

- Have a sense of graphics and other capabilities of sixth-generation games.
- Be familiar with the technological differences among sixth-generation consoles.
- List some of the key video game titles and peripherals for each console.
- Recognize the importance the new technology had on the video game industry.
- Summarize a brief overview of Microsoft and its Xbox video game console.
- Provide reasons for why Sega bowed out of the home console market.
- Explain why Sony dominated the fifth-generation market.
- Account for why the Xbox was less successful in Japan versus the United States.
- List several innovations introduced to gaming during this time period.
- Be familiar with people who helped pave the way for these games and consoles.
- Summarize sixth-generation market sales, breakthroughs, and trends.

■ KEY TERMS AND PEOPLE

3dfx
Acclaim
J Allard
Paul Allen
AMD
ArtX
ASCII keyboard controller
Kenichiro Ashida
Atari
ATI
Kevin Bachus
BASIC
Otto Berkes
BioWare
Seamus Blackley
Broadband
Bungie Studios
Chuck E. Cheese's
Cordless Action Controller
Dave & Buster's
DirectX
DK Bongos
Dream Blaster
Dreamcast
Dreameye
Driving Force GT
DualShock 2
Duke controller
DVD
Ed Fries
Electronic Arts
Emotion Engine
Ethernet
EyeToy
Factor 5
Cameron Ferroni
Firmware
Flipper GPU
Floating-point unit
Game Boy Advance
Game Boy Player
GameCube
Bill Gates
GCN-GBA cable
GD-ROM
Gekko CPU
Gigaflops
GunCon 2
Ted Hase
Hitachi SH4
IBM
IEEE 1394
Intel
Satoru Iwata
Isao Okawa
Jump Pak
Hideo Kojima
Ken Lobb
Logitech
Horace Luke
Richard Marks
Matsushita EI
Microsoft Corporation
Microsoft Office
Shigeru Miyamoto
Modem
Peter Moore
MS-DOS
Multitap
NAOMI
Network Adapter
Network Play
Leonard Nimoy
Nvidia
Isao Okawa
Pentium III
PlayStation 2/Slim
Polygons per second
Progressive scan
Rare
Redemption game
Retro Studios, Inc.
Rhythm game
Rockstar Games
Sammy
Sandbox game
Hideki Sato
Brian Schmidt
Second level cache
Silicon Knights
Bernie Stolar
System Link
Tecmo
Toshiba
VGA Box
VideoLogic PowerVR2
Visual Concepts
VMU
Voodoo 3
VPU0 and VPU1
WaveBird
Windows/95
Xbox
Xbox Live
Tatsuo Yamamoto
Hiroshi Yamauchi
Wei Yen

■ CONSOLE TIMELINE



■ ARCADE DECLINE AND RESTRUCTURING

With the rising cost of arcade games and near-identical graphics and sound on home consoles, many gamers began to choose the convenience of playing games at home. Video game rentals became increasingly more popular and retail sales continued to rise. This shift boosted the home console market, but resulted in a sharp decline in arcade gaming revenue throughout the end of the decade. *The Wall Street Journal* reported that arcade revenues in the United States dropped all the way down to $1.33 billion in 1999 (Henry, 2001, p. 3). Consequently, many small arcade venues (such as those found in malls) began to gradually disappear.

With better graphics and sound no longer being motives for gamers to go the arcades, other reasons people traveled to the arcades were for the social experience, cooperative gaming, or head-to-head competition of fighting and other competitive games. Eventually **broadband** (high speed) Internet and online gaming would allow gamers to play cooperatively or competitively online, reducing many people's desire to leave their homes and TVs. The industry had to evolve to stay relevant. Revenue from arcade machines was no longer enough to support most venues, so a greater emphasis on food and beverage service became necessary.

Venues like **Chuck E. Cheese's** and **Dave & Buster's** are prime examples of this strategy. They also provide experiences that consumers cannot always duplicate in the home—such as super large screens, unique game controllers, and motion-controlled cabinets. Shooting and racing games have remained popular for these very reasons.

FIGURE 10.1 Dance Dance Revolution (1999).

Konami's *Dance Dance Revolution* (Figure 10.1) popularized the **rhythm game** genre, becoming a hit for its unique competitive play, as well as a spot for skilled gamers to show off their dance moves. Other arcade trends included the return to more physical-style games such as *Skee-Ball* and *Whack-A-Mole*, and a plethora of similar **redemption games** where players could accumulate tickets or points for prizes. See Figure 10.2 for other popular arcade games during this time period.

FIGURE 10.2 Screenshots of arcade hits from 2000: (a) *Silent Scope 2: Dark Silhouette (Konami)*, (b) *Marvel vs. Capcom 2 (Capcom)*, and (c) *18 Wheeler: American Pro Trucker (Sega).*

(a)

(b)

(c)

■ THE SIXTH GENERATION: SEGA DREAMCAST

The sixth generation gave birth to the 128-bit systems and would be the last era where bits were discussed when comparing consoles. From this generation forward, the focal point changed from bits to CPU/GPU power and RAM. Eventually features like **progressive scan** output and the ability to play titles online became priorities. The generation kicked off with a new console from Sega, in attempt to reestablish retailer and consumer confidence in the company and to reach a broader audience.

Sega's new system began as two separate projects, U.S. based project "Blackbelt" led by IBM veteran **Tatsuo Yamamoto** followed by internal development from longtime Sega console designer **Hideki Sato**. Sato's project, which would become codenamed "Katana" after the Japanese sword, proceeded unbeknownst to the U.S. development team. Both designs used "off the shelf" (commercially produced) parts, such as the **Hitachi SH4** processor, however they differed in their choice of graphics cards (GPUs). Yamamoto's team went with U.S. company **3dfx** for a custom version of its **Voodoo 3** card, while Sato's team chose the **VideoLogic PowerVR2** card by Japanese manufacturer **NEC** In 1997, 3dfx went public and "revealed Sega's blueprint for a new, unannounced console, and angered executives at Sega Japan" (Perry, 2009, p. 2). Even though the 3dfx chip was more powerful, Sega ultimately chose Sato's design with the NEC graphics card.

The **Dreamcast** (Figure 10.3) debuted in Japan on November 27, 1998 for ¥329,800 (approximately $260). Sega sold out of its initial shipment of 150,000 units but may have been able to sell up to twice as many units had it not been (ironically) for manufacturing problems which prevented NEC from producing enough graphics cards (Kent, 2001, p. 563). Further challenge arose when on March 2, 1999 Sony announced the specs for its mighty new system that would be ready the following year—leading many to hold onto their wallets.

It was up to Sega of America president **Bernie Stolar** and his team to ensure a more successful U.S. launch. They did a lot of good, such as repairing relationships with American retailers and securing a better lineup of games. While the Japanese debut only had four launch titles, a record-breaking 19 titles were available for the U.S. release (Table 10.1)—including a long-awaited *Sonic* game. The American console maintained the look of the Japanese system, focusing more on the name "Dreamcast" than "Sega." Other clever marketing included the memorable U.S. launch date "9.9.99" (see Figure 10.5) and lower retail price of $199. However, with all the cards lined up, an argument with Sega chairman **Isao Okawa** led to Stolar's termination from the company just a month before the system's launch. Despite the abrupt loss of its president, Sega's U.S. Dreamcast debut was a success, with more presales than Sony had with the PlayStation during its entrance into the market.

The Dreamcast had a lot of things going for it when it was released. It was the most powerful home console at the time. It used its own **GD-ROM** (Gigabyte Disc) format for its media, which cost about the same as a CD-ROM to manufacture, but could hold up to 1.2 GB of data. While CD-ROMs were easy to copy, the higher capacity of GD-ROMs made Dreamcast games more difficult to pirate. The console also included four controller ports. The Dreamcast controller featured an

FIGURE 10.3 Sega Dreamcast console and controller with LCD screen memory card.

TABLE 10.1 Sega Dreamcast U.S. Launch Titles

- AeroWings
- AirForce Delta
- Blue Stinger
- Expendable
- Flag to Flag
- The House of the Dead 2
- Hydro Thunder
- Monaco Grand Prix
- Mortal Kombat Gold
- NFL 2K
- NFL Blitz 2000
- Pen Pen TriIcelon
- Power Stone
- Ready 2 Rumble Boxing
- Sonic Adventure (Figure 10.4a)
- SoulCalibur (Figure 10.4b)
- TNN Motorsports Hard core Heat
- Tokyo Xtreme Racer
- TrickStyle

analog stick, d-pad, and four action buttons, in addition to two touch-sensitive shoulder triggers. The center of the controller housed a slot for the 128 KB **VMU** (Visual Memory Unit) memory that contained both a small LCD screen, as well as single channel audio output. Since the console was not built with a reset button, players needed to reset games with the controller by pressing the Start button and the four face buttons (A+B+X+Y) simultaneously.

Another unique feature of the Dreamcast was that it included a built-in **modem** for connecting to the Internet for online play. However, it wasn't until a full year after its North American release when the Dreamcast's Internet gaming service **SegaNet** became available on September 7, 2000 under new Sega of America president **Peter Moore**. Most consumers at this time connected to the Internet with a slow 56 K modem and a subscription to SegaNet cost $21.95 per month. Still, Sega was able to obtain more than a million subscribers within its first month of service (Sega Enterprises, Ltd., 2000, p. 2). Free one-year subscriptions were soon offered with the purchase of every new Dreamcast. Following a price drop to $149, Sega even offered a rebate for the full price of the system, where consumers could literally receive a "free" Dreamcast with the purchase of an 18-month SegaNet subscription.

DID YOU KNOW?

Over 5000 names were considered for the Dreamcast For its logo, "in Japan and the U.S. the Dreamcast swirl is orange, but it had to be changed to blue in Europe due to a German company using the exact same logo" (McFerran, 209, pp. 239–240).

FIGURE 10.4 Screenshots of Dreamcast launch titles (a) *Sonic Adventure* and (b) *SoulCalibur*.

(a)

(b)

FIGURE 10.5 Magazine advertisement for the Dreamcast in 1999.

For peripherals, the Dreamcast received the typical arcade joystick variants, steering wheel, fishing controller for games like *Sega Bass Fishing*, and a keyboard and mouse for games like *The Typing of the Dead* Sega's VMU was much more than just a memory card Its interactive LCD display allowed for each player to have their own private screen, which could be used in new ways such as for calling plays in *NFL 2K* The controller slot for the VMU could also be used to insert a **Jump Pak** for force feedback. The slot was even used to plug in a microphone that was required for the bizarre *Seaman* title, narrated by **Leonard Nimoy** in the English-language version. The game involved caring for and talking to virtual fish-like creatures with human faces—who also spoke!

Possibly due to the Columbine High School massacre, Sega never released a light gun in the United States—however, third-party manufacturer Mad Catz did release their **Dream Blaster** light gun for the system. Sega's **Dreameye** was a digital camera accessory that could be connected to the system for exchanging pictures or used like a webcam for video chat. Perhaps the most unique accessories for the system were a pair of **maracas** that gamers would actually shake to the music of *Samba de Amigo*. Finally, the **VGA Box** adapter allowed the Dreamcast to output progressive scan (480p) on capable displays.

■ CONSOLE COMPARISON

Unlike the Saturn, the Dreamcast was built to be easy to program games for. *Retro Gamer's* Damien McFerran praised the system's motherboard as being "a masterpiece of clean, uncluttered design and compatibility" including development tools for Microsoft Windows CE, in addition to Sega's own development kits (McFerran, 2009, p. 240). The fastest processor in the previous generation was The N64's NEC VR4300 processor, which ran at 93.75 MHz. By contrast, the Dreamcast's Hitachi SH-4 32-bit RISC clocked at **200 MHz** with additional bells and whistles outlined in Table 10.2.

The Dreamcast was theoretically capable of rendering 7 million raw polygons per second, but a more realistic figure is about **3 million PPS** since "game logic and physics reduce peak graphic performance" (Hagiwara, 1999). Still, this was nearly 10 times the polygon count of Sony PlayStation and more than 30 times that of Nintendo 64.

Its GD-ROM format could hold nearly twice the amount of game data as a CD-ROM and the Dreamcast's **16 MB of RAM** was eight times the memory of PlayStation and four times the N64 without an Expansion Pak By this generation, all new game systems used optical media and contained comparable stereo sound. Surround sound would be the next step for home consoles; however, its quality and usage was up to each developer.

■ KEY DREAMCAST TITLES

More than 600 titles were officially published for the Dreamcast, of which about 250 were released in the United States. Sega's $10 million purchase of *NFL 2K* developers **Visual Concepts** led to *Madden* developer **Electronic Arts** abandoning support of the Dreamcast altogether (Fahs, 2009, p. 9). While not having any EA titles on Dreamcast may have hurt the system, the *2K* series matured into a notable sports franchise and became the biggest competitor to EA Sports Capcom, on the other hand, attracted the attention of action/adventure enthusiasts when *Resident Evil – Code: Veronica* (shown in Figure 10.6) debuted on the system.

TABLE 10.2 Sega Dreamcast Tech Specs

Manufacturer:	Sega Electronics
Launch price:	$199.99
Release date:	11/27/98 (JP), 9/09/99 (US), 10/14/99 (EU), 11/30/99 (AU)
Format:	12× speed GD-ROM "Giga Disc" (1.2 GB)
Processors:	128-bit HitachiSH-4 CPU (200 MHz), PowerVR2 CLX2 GPU
Performance:	100 MHz GPU/3+ million PPS (2+ million w/effects)
Memory:	16 MB RAM, 8 MB video RAM, 2 MB audio RAM
Resolution:	640 × 480 pixels
Sound:	Yamaha AICA –64 channel, 32-bit stereo, at 48 KHz

FIGURE 10.6 Box art to five popular Dreamcast titles including: (a) *Resident Evil – Code: Veronica*, (b) *NFL 2K1*, (c) *SoulCalibur*, (d) *Jet Grind Radio*, and (e) *Sonic Adventure*.

(a) (b) (c) (d) (e)

Because the Dreamcast was built from the same technology as Sega's **NAOMI** (New Arcade Operation Machine Idea) arcade hardware, "home conversions were more often than not exact replicas of what was seen in the arcade" (McFerran, 2009, p. 241). Consequently the system received ports of just about every NAOMI-based arcade game at that time, including fighting games like *Dead or Alive 2* and *Marvel vs. Capcom 2* and driving games like *18 Wheeler* and *Crazy Taxi* Arcade guru Yu Suzuki's "interactive novel" style game *Shenmue* cost upward of $50 million to make, but was a commercial failure (Kent, 2001, p. 578) despite positive reviews. Notwithstanding its losses, a sequel was released a year later although *Shenmue II* was never released for the U.S. Dreamcast.

HEAD-TO-HEAD

To compare the graphics and sound between the Dreamcast and PlayStation or N64, check out each system's version of *Gauntlet Legends*, *Hydro Thunder*, *NFL Blitz*, *Rayman 2: The Great Escape*, and *Ready 2 Rumble Boxing*.

FIGURE 10.7 Sony PlayStation 2 with DualShock 2.

■ SONY PLAYSTATION 2

After a year of being the promise that kept many gamers from buying a Dreamcast, Sony released the **PlayStation 2** (PS2) (Figure 10.7) in Japan on March 4, 2000 for ¥39,800 yen ($364). All 600,000 available units sold out in just three hours (Kent, 2001, p. 570). The PS2's unique design abandoned the circle-heavy look of the PS1 in favor of a simpler, more sophisticated look. The console could rest either flat or vertically, more similar to a small PC than the typical video game console. One of its major assets was its ability to play **DVDs** (Digital Versatile Discs) and a PS2 cost about the same or less than a regular DVD player at the time.

In addition to playing CDs and DVDs, the PS2 was backward compatible with just about all original PlayStation games. Its memory card slots and controller ports supported PS1 peripherals, although the 1 MB PS1 memory cards could only be used for PS1 games and PS1 controllers were not always fully compatible with PS2 games. Technological advances allowed PS2 memory cards to hold 8 MB or more data and the

new **DualShock 2** controller included pressure sensitive buttons. The PS2 also added a **USB** (Universal Serial Bus) and **IEEE 1394** (Firewire) expansion port for peripherals.

The American version (with upgraded **firmware**) made its U.S. debut on October 26, 2000 for $299.99 (Figure 10.9). A parts shortage resulted in only 500,000 units being available on launch day, "with an additional 100,000 consoles being shipped into the United States every week for the remainder of the year" (Kent, 2001, pp. 585–586). Even with its delays, the PS2 continued to outsell the Dreamcast, in part due to its own record-breaking 28 titles available at launch (Table 10.3), DVD-player capability, and sheer processing power.

The PS2 was powered by a custom 128-bit CPU developed by Sony and **Toshiba** Dubbed the **"Emotion Engine"** by Ken Kutaragi, the processor was hyped for being capable of producing graphics realistic enough to both convey and provoke human emotion. According to Steve Kent (2001), "its graphics processor had 1,000 times more bandwidth than current PC graphics processors at the time and its floating-point calculation performance was rated at 6.2 **gigaflops** (billion) per second, making it as fast as most super computers" (p. 561).

Since the system could also be used as a CD and DVD player, much of the marketing around the PS2 focused on its value as a home entertainment machine. Its main slogan (which began on the PS1) was "Live in Your World, Play in Ours." It was difficult for Sony to target a specific audience for the PS2 Much of the gaming world had grown up, and "players who became captivated as children [were] now buying more advanced hardware and more sophisticated software" which led to a target market age range as wide as 16–26 years old (Marketing Papers, 2017, p. 3). Many consumers may have initially purchased the system because it was an affordable DVD player and only later decided to purchase games for it.

Early PS2 games were manufactured on either CD-ROM or DVD-ROM format. CD-ROM games could be identified by their blue bottom side, while DVD-ROMs were silver. Among the system's 28 launch titles were a handful of standout games to help the system compete with the Dreamcast's established library. Key introductory titles included *DOA2: Hardcore, SSX, Tekken Tag Tournament, TimeSplitters*, and *Unreal Tournament*.

DID YOU KNOW?

With the Dreamcast failing to reach its sales goals to keep the company afloat, Sega discontinued production of the system on March 31, 2001, opening up the field for Sony's PlayStation 2 to become the only active piece of hardware in the sixth generation for a period of six months (Briers, 2016, para. 6).

TABLE 10.3 Sony PlayStation 2 U.S. Launch Titles

- Armored Core 2
- DOA2: Hardcore
- Dynasty Warriors 2
- ESPN International Track & Field
- ESPN Winter X Games Snowboarding
- Eternal Ring
- Evergrace
- FantaVision
- Gungriffon Blaze
- Madden NFL 2001
- Midnight Club: Street Racing
- NHL 2001
- Orphen: Scion of Sorcery
- Q-Ball: Billiards Master
- Ready 2 Rumble Boxing: Round 2
- Ridge Racer V
- Silent Scope
- Smuggler's Run
- SSX (Figure 10.8a)
- Street Fighter EX3
- Summoner
- Surfing H3O
- Swing Away Golf
- Tekken Tag Tournament (Figure 10.8b)
- TimeSplitters
- Unreal Tournament
- Wild Wild Racing
- X-Squad

PRO FILE

KEN KUTARAGI

KEY FACTS:

Developed the first three PlayStation consoles and the PlayStation Portable.

Often called "The Father of PlayStation"

PRO FILE

HISTORY:

- Born: August 2, 1950, Tokyo, Japan

EDUCATION:

- Electronics degree from DenkiTsūshin University of Electro-Communications, Chōfu, Tokyo, Japan

CAREER HIGHLIGHTS:

- Joined Sony Corporation in 1975
- Designed the S-SMP audio chip for the SNES
- Developed the SNES CD-ROM adapter that became the widely successful PlayStation console
- Named chairman and CEO of Sony Computer Entertainment of America in April of 1997
- Became president and CEO for Sony Computer Entertainment, Inc. in 1999
- His PS2 is the best-selling game console of all time

RECOGNITION:

- Lifetime Achievement Award at the 14th Annual Game Developers Choice Awards, March of 2014

FIGURE 10.8 Screenshots from PS2 launch titles (a) *SSX* and (b) *Tekken Tag Tournament*.

(a) (b)

Sony released an optional infra-red **DVD remote control** to accompany its DVD playback functionality. Other common accessories included the **Multitap** adapter (for connecting four controllers and memory cards), component cables, **GunCon 2** (light gun), guitars and dance pads for rhythm games, a USB keyboard and mouse, and a headset for communicating in multi-player games or for voice commands in certain titles. A hard disk drive (HDD) was also made available but only around 35 titles were compatible.

The PlayStation **Network Adapter** hit store shelves in late 2002, allowing gamers to play online via the PS2 **Network Play** service. In October 2003 Sony released its **EyeToy** color digital camera conceived by **Richard Marks** and manufactured by **Logitech** The webcam-like device would become a major influence on the next generation of consoles with its focus on controlling games with motion. Other peripherals by Logitech included the **Driving Force GT** steering wheel kit and the **Cordless Action Controller**. A smaller, quieter PS2 called the **PlayStation 2 Slim** launched on November 1, 2004. The new model included a top-loading disc tray (like PS1) and a built-in Network Adapter.

■ CONSOLE COMPARISON: PLAYSTATION 2 VERSUS DREAMCAST

In contrast to Dreamcast's 1.2 GB Giga Discs, PS2's DVD-5 (single layer) discs could hold up to 4.7 GB of data, while a number of DVD-9 (dual layer) games were manufactured with a capacity of 8.5 GB (Table 10.4). At first glance, the PS2 blew away the competition, with a claim of 75 million raw polygons per second versus around 3 million PPS on the Dreamcast. However, when using textures, lighting, and other effects, the PS2's true polygon count "could be as low as three million polygons, as seen in games like *Ridge Racer V* and as high as 20 million" (IGN, 2000a, para. 6). Still, the PS2 was the most powerful system on the market at the time of its release.

The PS2's CPU took some time for programmers to grasp, since it operated best in tandem with its **vector processing units VPU0** and **VPU1**), its graphics synthesizer GPU, and its **floating-point unit** (FPU) math co-processor to render 3D graphics. While first-generation PS2 software was certainly comparable to Dreamcast games, it wasn't until developers mastered use of the CPU's vector units where a substantial

FIGURE 10.9 Target Stores magazine advertisement for the Sony PlayStation 2 in 2000.

TABLE 10.4 PlayStation 2 Tech Specs

Manufacturer:	Sony Computer Entertainment
Launch Price:	$299.99
Release Date:	3/04/00 (JP), 10/26/00 (US), 11/24/00 (EU), 11/30/00 (AU)
Format:	CD-ROM and DVD-ROM (up to 8.5GB)
Processors:	128-bit "Emotion" RISCCPU (295–299 MHz), GFX Synthesizer
Performance:	"GS" GPU (147 MHz) 75 million PPS (20 million with effects)
Memory:	32 MB main RAM, 4 MB video RAM
Resolution:	720 × 480i, 720 × 480p, 1920 × 1080i (upscaled)
Sound:	48-channel, Dolby Digital Surround, at 44.1 or 48 KHz

difference in graphics could be realized. Like the late Dreamcast **Broadband Adapter,** the PS2's Network Adapter was capable of connecting via **Ethernet** for high speed Internet gaming.

HEAD-TO-HEAD

To compare gameplay between early PS2 and Dreamcast games, check out these titles released on both systems: *4×4 Evolution*, *Dead or Alive 2* (*DOA2*), *MDK2*, *Ready 2 Rumble Boxing: Round 2*, *Resident Evil – Code: Veronica*, and *Unreal Tournament*.

■ KEY PLAYSTATION 2 TITLES

Around 1850 different titles were released for the PS2 A big part of the PS2's success was its plethora of high-profile, often exclusive titles (Figure 10.10). The system was first to receive the groundbreaking **"sandbox"** (open world) games *Grand Theft Auto III, Grand Theft Auto: Vice City*, and *Bully* by **Rockstar Games**. The PS2 was also first to receive **Hideo Kojima's** story-driven, motion picture-like *Metal Gear Solid 2: Sons of Liberty* and the exclusive console for its follow-up, *Metal Gear Solid 3: Snake Eater*.

Lucrative Sony-published titles included two epic *God of War* action/adventure games, as well as dual entries from the *Gran Turismo* racing series and *Dark Cloud* RPG franchise. Other games released by Sony included *Twisted Metal Black*, the emotional *Ico* and *Shadow of the Colossus* titles, as well as the *Sly Cooper* trilogy to name a few.

Speaking of trilogies, the system received numerous trifectas from a variety of game publishers, with no less than three titles from the *Jak* series by *Crash Bandicoot* developers Naughty Dog, the *Devil May Cry* and *Onimusha* games by Capcom, survival horror hits *Fatal Frame* (Tecmo) and *Silent Hill* (Konami), along with role-playing trilogies from *Final Fantasy* (Squaresoft/Square Enix), *Shadow Hearts* (Midway/Xseed), and *Xenosaga* (Namco).

Even Sega published several exclusive titles on the system, such as *Virtua Fighter 4, Shinobi, Nightshade*, and the first two games in the *Yakuza* series. The PS2 attracted more third-party support than any other system that generation, reinforcing the golden rule that distinguished and exclusive software ultimately drives console sales.

FIGURE 10.10 Five defining PS2 titles: (a) *Metal Gear Solid 2: Sons of Liberty*, (b) *Ratchet & Clank: Going Commando*, (c) *Grand Theft Auto III*, (d) *God of War*, and (e) *Shadow of the Colossus.*

(a) (b) (c) (d) (e)

HANDHELD SNAPSHOT: GAME BOY ADVANCE

Designed by **Gwénaël Nicolas** and **Curiosity Inc.,** Nintendo's 32-bit **Game Boy Advance** (Figure 10.11) released in the United States on June 11, 2001 for $99.99. See Table 10.5 for specs. Similar to a portable SNES, it added two shoulder buttons and was also backward compatible with Game Boy and Game Boy Color. Like those systems, GBA lacked a backlit screen until the updated **Game Boy Advance SP** model debuted in 2003.

That same year, the **Game Boy Player** dock was released for Game Cube, allowing GBA (as well as Game Boy and Game Boy Color) games to be played on a TV. A third handheld model called **Game Boy Micro** was released in 2005. Over 1000 games were published for the GBA (see Figure 10.12 for top picks), with more than 81 million systems sold (Nintendo, 2010). Nintendo continued its dominance over the handheld market, leaving the **NeoGeo** leaving the **NeoGeo Pocket Color** and **Nokia N-Gage** (which doubled as a cell phone) unable to compete.

FIGURE 10.11 Game Boy Advanc.

TABLE 10.5 Game Boy Advance Tech Specs

Format:	Cartridge/2 AA batteries (approximately 15 hours)
Processor:	32-bit ARM7TDMI (16.8 MHz) with 8-bit Z80 co-processor
Memory:	32 KB RAM, 96 KB VRAM + 256 KB DRAM (outside CPU)
Resolution:	240 × 160 pixels/2.9" diagonal LCD screen
Colors:	512 from a palette of 32,768
Sound:	6-channel (two 8-bit) with 3.5 mm stereo headphones jack

FIGURE 10.12 Box art to GBA hits (a) *Castlevania: Aria of Sorrow*, (b) *Metroid: Zero Mission*, (c) *WarioWare: Twisted!*, (d) *Pokémon Emerald*, and (e) *The Legend Of Zelda: The Minish Cap.*

(a)

(b)

(c)

(d)

(e)

■ NINTENDO GAMECUBE

Nintendo's next home console was internally known as "Project Dolphin." It's **"Flipper"** graphics processor was developed by **ArtX,** an electronics company comprised of former Silicon Graphics, Inc. engineers and founded up by N64 graphics chip developer Dr. **Wei Yen**. ArtX was acquired by **ATI** (Array Technology Inc.) in April 2000 after most of the work on the chip had been completed (Parker, 2001, para. 4). The console's CPU was code-named **"Gekko"** and was developed by computer giant **IBM** (International Business Machines). Before the system's release, longtime Nintendo of America Chairman **Howard Lincoln** would retire to become owner of the Seattle Mariners baseball team.

The system was officially named **GameCube** (Figure 10.13) due to its box-like shape. The casing was designed by **Kenichiro Ashida** and his team, who sought a compact, portable, friendly-looking system (Rogers, 2014, pp. 13–14). It even had a curved handle attached to the rear of the unit for easy carrying. The system was first available in two colors (indigo and jet black) and a platinum color "limited edition" GameCube would be released a year later.

Other design considerations for the system included four controller ports, two memory card slots, as well as being the first Nintendo console to use optical media. Designed by **Matsushita Electric Industrial** (Panasonic), the MiniDVD-based discs were developed with enhanced copy protection as a priority (Hara, 1999, para. 7).

DID YOU KNOW?

Only the original indigo and jet black GameCube consoles included an output for component (progressive scan) display. Nintendo removed the output on the platinum model and eventually discontinued it on later models (presumably to save money).

The smaller (8 cm) GameCube game discs could only hold up to **1.5 GB** of data and, as such, there were a number of titles that required two discs. The system was not capable of playing standard DVDs or audio CDs. On the other hand, the system *was* created "to attract third-party developers by offering more power at a cheaper price" (IGN Staff, 1999, para. 17). See Table 10.6 for a list of launch titles.

The GameCube debuted in Japan on September 14, 2001, shipping approximately 500,000 units—followed by another 700,000 units launched in the United States on November 18th. It was another launch record for Nintendo and the company reportedly spent an estimated $75 million dollars on its launch campaign, including "a celebrity-studded Hollywood party featuring celebrities such as Ryan Reynolds, Paris Hilton,

FIGURE 10.13 Nintendo GameCube console, controller, and one black memory card.

TABLE 10.6 Nintendo GameCube U.S. Launch Titles

- All-Star Baseball 2002
- Batman: Vengeance
- Crazy Taxi
- Dave Mirra Freestyle BMX 2
- Disney's Tarzan Untamed
- Luigi's Mansion (Figure 10.14a)
- Madden NFL 2002
- NHL Hitz 20-02
- Star Wars Rogue Squadron II: Rogue Leader (Figure 10.14b)
- Super Monkey Ball
- Tony Hawk's Pro Skater 3
- Wave Race: Blue Storm

Tara Reid, Christina Aguilera, Michelle Rodriguez, and Lil' Kim" (Rogers, 2014, p. 40). Priced at just $199, it was the most affordable new console (not counting the discontinued Dreamcast) going into the holiday season. Advertisements soon included the slogan "Born to Play," along with television commercials ending with a voice whispering "GameCube."

As with previous Nintendo consoles, its unique controller was designed by **Shigeru Miyamoto,** who set out to create a more optimal game pad after mixed reactions to the N64 controller. Miyamoto designed four to five versions before settling on the final product. The controller put an emphasis on the main "A" button, being surrounded by smaller buttons—all with varying shapes and sizes, which Miyamoto felt "help players identify each button's level of importance on the controller's layout" (Rogers, 2014, p. 21). The GameCube controller also included built in vibration feedback, along with two analog sticks—the right stick being labeled the "C-stick," which was predominantly used for camera control like the four yellow "C" buttons on the N64 controller. The top of the game pad housed two pressure-sensitive (clickable) "L" and "R" trigger buttons, along with a smaller, purple "Z" shoulder button on the right side. The only part of the controller that seemed like an afterthought was the d-pad, which was smaller and less responsive than d-pads from previous Nintendo controllers. In 2002, Nintendo introduced the earliest first-party wireless controller with the **WaveBird**. The WaveBird ran on just two AA batteries but lacked the vibration feature of the standard controller.

Other peripherals included memory cards that could hold between 4 MB and 64 MB of game data, **DK Bongos** for rhythm games like *Donkey Konga*, a microphone, racing wheel, and an **ASCII keyboard controller** (which looked like a standard GameCube controller with a full-size computer keyboard in the middle of it).

The GameCube also featured accessories for interacting with the Game Boy Advance handheld. The **GameCube-Game Boy Advance (GCN-GBA) cable** was a link cable developed for players to access exclusive

FIGURE 10.14 *Screens of* (a) *Luigi's Mansion and* (b) *Star Wars Rogue Leader: Rogue Squadron II.*

(a)

(b)

content in certain GC games (such as *The Legend of Zelda Four Swords Adventures* and *Final Fantasy Crystal Chronicles*) by using the GBA as a second screen and controller. The **Game Boy Player** dock allowed gamers to play Game Boy, Game Boy Color, and GBA games on their TV.

What the console severely lacked was online gaming support. While a broadband and modem adapter were developed for the system, just a handful of games utilized a LAN connection and only Sega's *Phantasy Star Online* games (and a game called *Homeland* in Japan) could be played online.

■ CONSOLE COMPARISON: GAMECUBE VERSUS PLAYSTATION 2

The GameCube and PS2 were very different animals indeed. The GameCube was designed to be easier to program for, avoiding the more complex architecture of the PS2 where tasks were divided between its CPU and two Vector Units. "Whereas PlayStation 2's CPU and two Vector Units split up the tasks of various graphic procedures, like transformation and lighting, for example, all of this is handled singularly by Gamecube's Flipper chip, which also decompresses textures at a 6:1 ratio" (IGN Staff, 2000a, para. 17).

By itself, the GameCube's **485 MHz** Gekko CPU (Table 10.7) was much faster than PS2's 299 MHz processor. And while its floating-point calculation performance was rated at just **1.9 gigaflops** compared to 6.2 GFLOPS on the PS2, the GC's 162 MHz Flipper graphics processor was rated at **9.4 GFLOPS**. Furthermore, the GameCube CPU's 256 KB of **second level cache** (which determines the speed of general game code) was leagues ahead of the 16 KB of second level cache used by the PS2.

Looking beyond the somewhat inflated raw polygon counts to polygons per second with effects, the systems' polygon counts were about equal. On the other hand, the GameCube was capable of rendering "up to eight effects layers to a polygon in a single pass, whereas the PS2 features a multi-pass rendering system … so essentially PS2 [had] to render 1,000 polygons eight times over whereas GameCube only [had] to render 1,000 polygons once for the same effect" (IGN Staff, 2000a, para. 19).

While GameCube had many clear advantages, experienced programmers were eventually able to develop techniques to conquer many of the PS2's shortcomings. Beyond pure performance, the GameCube's small disc capacity and lack of multimedia options (such as DVD playback and significant online gaming) gave PS2 a market edge.

■ KEY GAMECUBE TITLES

More than 600 games were released for the GameCube Returning first-party favorites included *Super Mario Sunshine* (Figure 10.15), *The Legend of Zelda: The Wind Waker* and *Twilight Princess, Mario Kart: Double Dash!!*, and the console's best-selling game, *Super Smash Bros. Melee* (shown in Figure 10.16) Nintendo also introduced new franchises on the system such as *Pikmin* and *Animal Crossing*, while in-house **Retro Studios, Inc.** brought the *Metroid* franchise to 3D with two *Metroid Prime* releases. Initially criticized for even attempting to evolve the series to 3D, the *Metroid Prime* games exceeded all expectations and became two of the best titles on the system. Key N64 developer **Rare** released its last Nintendo exclusive with *Starfox Adventures* before being sold to Microsoft in 2002 (McFerran, 2016, p. 171).

TABLE 10.7 Nintendo GameCube Tech Specs

Manufacturer:	Nintendo
Launch Price:	$199.99
Release Date:	9/14/01 (JP), 11/18/01 (US), 5/03/02 (EU), 5/17/02 (AU)
Format:	8 cm optical disc (1.5 GB)
Processors:	IBM Power PC "Gekko" processor (485 MHz) ATI "Flipper" GPU (162 MHz)
Performance:	90 million polygons per second (6 to 20 PPS with effects)
Memory:	24 MB main RAM, 3 MB video RAM, 16 MB audio RAM
Resolution:	640 × 480i, 640 × 480p
Sound:	64-channel, Pro Logic Surround Stereo at 48 kHz

FIGURE 10.15 Magazine advertisement for GameCube title *Super Mario Sunshine* in 2002.

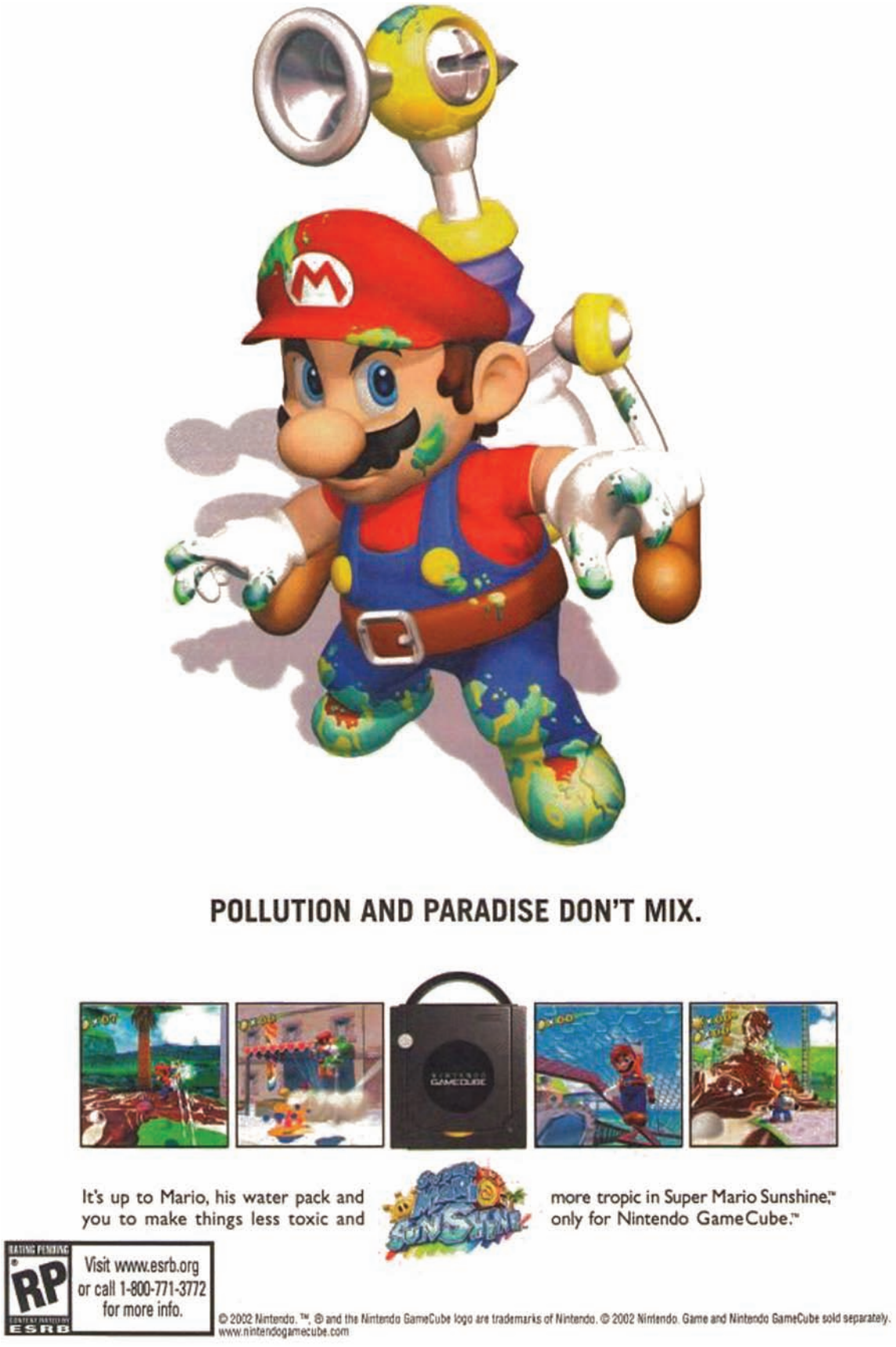


FIGURE 10.16 Five defining GameCube titles: (a) *Super Smash Bros. Melee*, (b) *Metroid Prime*, (c) *The Legend of Zelda: The Wind Waker*, (d) *Eternal Darkness*, and (e) *Resident Evil 4*.

(a) (b) (c) (d) (e)

Third-party support included **Factor 5**'s *Star Wars Rogue Squadron II: Rogue Leader* and its sequel *Rebel Strike*. Canadian developer **Silicon Knights** worked on just two GameCube games but both *Metal Gear Solid: Twin Snakes* (published by Konami) and *Eternal Darkness* (published by Nintendo) were Triple-A titles. **Atari** ported the Japanese Dreamcast exclusive shoot 'em up *Ikaruga* to the system as a U.S. exclusive and Sega ported many of its own Dreamcast hits like *Crazy Taxi, Skies of Arcadia Legends, Phantasy Star Online*, and its *Sonic Adventure* games. Sega's *Super Monkey Ball* franchise began as GameCube exclusives, but would later appear on competing consoles. Furthermore, in early 2003 Sega announced that it would be discontinuing all of its sports titles on the GameCube in favor of other platforms (Berghammer, 2003, p. 1). That same year, longtime developer **Acclaim** dropped support for GameCube altogether.

DID YOU KNOW?

"Out of the top 25 best-selling games for the GameCube, 19 of them were published by Nintendo" (Coulter, 2011, para. 16). The company's last official title for the system was its swan song, *The Legend of Zelda: Twilight Princess*.

Similar third-party issues came from Capcom, who also started off as a strong supporter for GameCube. Capcom initially announced five exclusive titles for the system, including survival horror shooters *Resident Evil 4* and *Killer7*, sci-fi shooter *P.N.03*, side-scrolling action-platformer *Viewtiful Joe*, and a shoot 'em up called *Dead Phoenix*. "In the end, the only title out of the fabled 'Capcom Five' to remain GameCube exclusive was *P.N.03*—the fifth game, *Dead Phoenix* was cancelled in 2003 and Suda51's *Killer7* launched on the GameCube and PlayStation 2 at the same time" (McFerran, 2016, p. 172). To its credit, Capcom did maintain other amazing exclusives for the system, including the remake of the original *Resident Evil* and its prequel, *Resident Evil Zero*.

HEAD-TO-HEAD

There were a number of games that were released on both the GameCube and PS2. Compare the gameplay and graphics to each system's version of *Extreme-G 3, Killer7, Resident Evil 4, Sonic Heroes, TimeSplitters 2*, and *Viewtiful Joe 1 & 2*.

■ CHANGES AT NINTENDO

Similar to how the previous generation saw a multitude of personnel changes at Sega, 2002 would become a major turning point for much of the leadership at Nintendo. It began in January, when Nintendo of America president **Minoru Arakawa** retired from the company. Two months later, Nintendo of America's **Ken Lobb** (producer/supervisor on projects such as *Star Wars Rogue Squadron II: Rogue Leader* and *Metroid Prime*) left the company to join Microsoft in March.

After more than 5 decades of running the company he inherited from his great grandfather, Nintendo president **Hiroshi Yamauchi** decided it was time to retire—although he would remain a board member for three more years. Head of Nintendo's Corporate

Planning Division, **Satoru Iwata,** replaced Yamauchi as the new president of Nintendo Co., Ltd that summer. Finally, on September 24, 2002 Nintendo sold Rareware to Microsoft "for 100% ownership for $375 million" (Rogers, 2014, p. 56).

■ MICROSOFT XBOX

Microsoft Corporation was founded by **Paul Allen** and **Bill Gates** on April 4, 1975. Headquartered in Redmond, Washington, the company quickly developed a reputation for its computer software and operating systems (OS). Starting with **BASIC** (Beginner's All-purpose Symbolic Instruction Code) interpreters for the Altair 8800, the company would begin to revolutionize personal computers with its **MS-DOS** operating system for IBM in the mid-1980s. The company developed a graphical extension for MS-DOS in 1985 called **Windows,** followed by its **Microsoft Office** suite in 1990. It was on August 24, 1995 when Microsoft released its **Windows 95** OS, solidifying its dominance in the personal computer world and skyrocketing past Apple in annual revenue.

Being the leader in PC operating systems, Bill Gates naturally felt threatened when early announcements of the PS2 positioned the system as a competitor to both the home entertainment and personal computer industries. His strategy was to build a better game console and compete directly with Sony. Development for Microsoft's first home console began with four engineers from Microsoft's **DirectX** (multimedia programming interfaces) team including **Kevin Bachus, Seamus Blackley, Otto Berkes,** and **Ted Hase** (Takahashi, 2011, p. 2). Shortly thereafter, head of Microsoft's game publishing division **Ed Fries** joined the team and the group set out to construct a home console based off of Microsoft's DirectX technology that was initially known as the "DirectX Box." Despite its unpopularity with Microsoft's marketing team, the name **"Xbox"** (Figure 10.17) outscored all other titles in focus tests and become the official name of the system (Alexander, 2009, para. 16).

J. Allard and **Cameron Ferroni** were put in charge of creating the Xbox's operating system, which was originally planned to run the Windows OS. After removing everything it didn't need, it became apparent that the system would not run Windows and it more or less became a DirectX operating system (Takahashi, 2011, p. 3). Still, the system's inner components more closely resembled a PC than any video game system before it. Similar to Sony's surprise when Nintendo announced that Philips would be manufacturing a CD drive for the SNES, "the Xbox was originally built using **AMD** [Advanced Micro Devices] hardware. At the last second, right before a major conference, the technology stack shifted to **Intel**" (White, 2015, para. 2).

In addition to using the PC-popular Intel **Pentium III** processor and an **Nvidia** graphics chip, the console also contained an 8 GB **internal hard drive** and a **broadband Ethernet port**. Although it wasn't the first home console to include internal storage, its 8 GB hard drive was much larger and more capable than the internal storage of the 3DO or Sega Saturn. In addition to game data storage, users could download game patches and even rip entire music CDs to the hard drive. The decision to make

FIGURE 10.17 Microsoft Xbox console with a "Controller S" model controller.

TABLE 10.8 Microsoft Xbox U.S. Launch Titles

- 4×4 EVO2
- AirForce Delta Storm
- Arctic Thunder
- Cel Damage
- Dark Summit
- Dead or Alive 3
- Fuzion Frenzy
- Halo: Combat Evolved (Figure 10.18a)
- Mad Dash Racing
- Madden NFL 2002 (Figure 10.18b)
- NASCAR Heat 2002
- NASCAR Thunder 2002
- NFL Fever 2002
- NHL Hitz 20-02
- Oddworld: Munch's Oddysee
- Project Gotham Racing
- Shrek
- Test Drive Off-Road Wide Open
- Tony Hawk's Pro Skater 2x
- TransWorld Surf

the system broadband-only (with no dial-up modem) seemed controversial at first; however, it raised the bar for online gaming and the absence of a dial-up modem saved Microsoft around $5.18 per unit sold (Takahashi, 2011, p. 3). That added up to an overall savings of $100 million.

DID YOU KNOW?

Seamus Blackley explained that the system's trademark green color was a product of the console's designer **Horace Luke**. Apparently, Luke had a fancy set of paint markers that everyone in the office would take except for the green ones, so all his artist renderings were done with green markers and the color stuck (McCaffrey, 2015).

The Xbox would be the first home game console made by an American company since the Atari Jaguar. It released first in North America on November 15, 2001 for $299.99—just two months after the 9/11 terrorist attacks on U.S. soil. Microsoft chose Toys "R" Us in the heart of Times Square for its launch party. Thousands of New Yorkers came out for the event, which was "bathed in acid green search lights. Microsoft gave them Krispy Kreme donuts with green sprinkles. Bill Gates walked up and down the line and shook hands with all of the fans" (Takahashi, 2011, p. 6). Compared to Nintendo's $75 million launch campaign for GameCube, Microsoft spent $500 million on the launch campaign for Xbox, including television and print ads, as well as "national promotions with companies such as Taco Bell, SoBe and Vans" (Rogers, 2014, p. 41).

More than a million Xbox consoles sold in its first three weeks on the market. Its popular first-person shooter (FPS) *Halo: Combat Evolved* would see similar success in its first few months on store shelves. *Halo* was

FIGURE 10.18 Screens of Xbox launch titles (a) *Halo: Combat Evolved* and (b) *Madden NFL 2002*.

(a)

(b)

the definitive system-seller for the Xbox, thanks to Microsoft's acquiring of the game's developer **Bungie Studios** in June 2000. "Xbox release dates in Japan (February 22, 2002) and Europe (March 14, 2002) soon followed, though the system failed to catch fire in either of the two regions with the same energy that fueled its arrival in North America" (Marshall, 2013, para. 10).

Its launch titles (Table 10.8) consisted primarily of sports and action games, which were not the style of games that attracted Japanese gamers. Its original controller (nicknamed the **"Duke"**) was so large that Microsoft designed a smaller "Controller S" model for the Japanese market. The Duke (shown in Figure 10.19) received plenty of criticism for its cumbersome shape and oval face buttons and within a year was replaced by the Controller S in all regions.

The system's online network "**Xbox Live** arrived in November 2002 with a starter kit to get users into multiplayer games. More than 150,000 people signed up in the first week" (Griffith, 2013, para. 7). Like the PS2, the Xbox offered DVD playback but required a separate remote and adapter. In addition to its external hard drive, users could store data on memory cards which plugged into the back of the controllers like N64.

The system received the standard line of peripherals including light guns, steering wheels, **System Link** cables (for LAN gaming), headsets, component cables, microphones, third-party wireless controllers, rhythm game accessories, keyboard and mouse. Perhaps its most unique accessory was the controller Capcom bundled with its *Steel Battalion* mech game. The $200 multi-section unit measured nearly three feet wide and

FIGURE 10.19 2001 Xbox ad featuring characters from *Tony Hawk's Pro Skater 2*, Abe from *Oddworld: Munch's Oddysee*, and the original "Duke" controller.

contained approximately 40 different buttons, multiple control sticks, and three foot petals.

■ CONSOLE COMPARISON: XBOX VERSUS THE REST

The Intel Pentium III CPU ran at an impressive **733 MHz** (Table 10.9)—more than twice the speed of the PS2 Emotion Engine, but about on par with the Gamecube's Gekko when considering all components. While GameCube's 485 MHz processor appears inferior on paper, its 256 K of second level cache made the Gekko and Pentium III comparable. This is because "the size of a CPU's second level cache determines how fast general game-code runs" (IGN, 2010a, para. 22). The PS2 included only 16 K of second level cache, while the Xbox had **128 K**. The Xbox's Nvidia **NV2A GPU** ran at 233 MHz—a faster clock speed than the GameCube's Flipper, but at a lower floating-point performance of **7.3 GFLOPS**.

Processing speed aside, the Xbox could push more polygons than either the GameCube or PS2, both raw or with various effects. On the other hand, its GPU could only run half of the number of effects layers to a polygon compared to GameCube, with **four effects layers** in a single pass. Overall, however, Xbox games typically looked the best when comparing the same titles on each console. In almost every case, the Xbox version of cross-platform games looked sharper—often containing extra details such as lighting and bump mapping effects not always included on the other consoles. The *Tom Clancy's Splinter Cell* series was a prime example of this.

Xbox also had an advantage in sound for gamers with the proper setup. Audio expert **Brian Schmidt** was able to integrate Dolby Digital 5.1 surround sound into the system—a first for home video game consoles. Other firsts included the ability for Xbox gamers to mod their system and download game patches via its built-in hard drive.

Online gaming only became a major feature of the Xbox and PS2. The original PS2 required an external network adaptor but accommodated both dial-up and broadband users. Xbox only supported broadband, but it was built into the system from the beginning. Gaming online with Xbox required a paid monthly subscription to Xbox Live, whereas online gaming with PS2 was managed by each game publisher and on their own servers. Ultimately, Xbox set the standard for online gaming on home consoles.

HEAD-TO-HEAD

Many Xbox games released on both GameCube and PS2. Compare all three systems by checking out each console's version of *007: Nightfire*, *Beyond Good and Evil*, *BloodRayne*, *Metal Arms: Glitch in the System*, and any of the *Prince of Persia* titles.

■ KEY XBOX TITLES

More than a thousand games were released for the Xbox. *Halo: Combat Evolved* quickly took the crown for best-selling launch title and its sequel *Halo 2* became the best-selling Xbox game of all time. For shooter fans, the *Halo* franchise was reason enough to buy the system. Other home console exclusives published by Microsoft Game Studios included Peter Molyneux's action-RPG *Fable*, two *MechAssault* games, and several racing series including *Project Gotham Racing*, *RalliSport Challenge*, and *Forza Motorsport*.

The system received exclusive support from **Tecmo** with its *Dead or Alive* and *Ninja Gaiden* franchises,

TABLE 10.9 Microsoft Xbox Tech Specs

Manufacturer:	Microsoft
Launch Price:	$299.99
Release Date:	11/15/01 (US), 2/22/02 (JP), 3/14/02 (EU & AU)
Format:	CD-ROM & DVD-ROM (up to 8.5 GB)
Processors:	Intel Pentium III CPU (733 MHz) Nvidia NV2A GPU (233 MHz)
Performance:	125 million polygons per second (29 million PPS w/effects)
Memory:	64 MB RAM with 8 GB hard drive
Resolution:	720 × 480i plus 480p, 576i, 576p, 720p, & 1080i
Sound:	64 3D channel, Dolby Digital 5.1 (plus DTS for movies)

FIGURE 10.20 Xbox hits: (a) *Star Wars: Knights of the Old Republic*, (b) *Burnout 3: Takedown*, (c) *Halo: Combat Evolved*, (d) *Tom Clancy's Splinter Cell: Chaos Theory*, and (e) *Ninja Gaiden Black*.

(a) (b) (c) (d) (e)

including a number of exclusive Sega titles such as *Panzer Dragoon Orta, The House of the Dead III*, and *Jet Set Radio Future*. Developer **BioWare** made a name for itself on the console with its renowned *Jade Empire* and *Star Wars: Knights of the Old Republic* (in Figure 10.20) RPGs. The acquisition of Rare on the other hand, only led to the mediocre *Grabbed by the Ghoulies* and updated N64 game *Conker: Live & Reloaded.*

Sony's PS2 was the debut console for the first two *Grand Theft Auto* games, but the games looked far superior when they were later released on the Xbox. Sports games (especially the *2K* series) also looked the best on Xbox—often containing scenes and features not seen on competing consoles. Such was the case with most cross-platform games, with the Xbox version of titles often featuring additional special effects and progressive scan support. While only around a quarter of all PS2 games featured progressive scan support, 480p was pretty much a standard option in most Xbox games. Unfortunately, most gamers did not have enhanced or high definition TVs during this time to take full advantage of these features.

■ SIXTH-GENERATION MARKET SUMMARY

Despite a successful launch, the Dreamcast's 3 million units sold in America fell far short of Sega's goals and the company was incurring major financial losses. Several price cuts later, including the rebate offer where consumers could obtain a free Dreamcast with an 18-month SegaNet subscription, were simply not enough to keep the company afloat. On January 24, 2001, Sega announced it would be discounting the Dreamcast. Less than three months later, the company would lose co-founder and chairman Isao Okawa to congestive heart failure after a battle with cancer—but not before he gifted his entire $695 million worth of Sega and CSK stock to help the company survive its third-party transition (Kent, 2001, pp. 588–589). The Dreamcast would become Sega's last home video game system, ending its 18-year-run as a console manufacturer.

The company repositioned itself as a sole software publisher and continued to manufacture Dreamcast games for about a year, in addition to releasing many third-party (often exclusive) titles for PlayStation 2, GameCube, and Xbox. In 2004, pachinko manufacturer **Sammy** acquired Sega for $1.4 billion, becoming **Sega Sammy Holdings Inc**. The restructuring would result in nearly one-third of Sega's Tokyo workforce being laid off, as well as the departure of Sonic Team leader Yuji Naka who left in 2006, followed by significantly reduced contributions by Sega's arcade pioneer Yu Suzuki a few years later (Fahs, 2009, p. 11). Despite its many losses, Sega maintained its status as a leading manufacturer of arcade games and continues to be a reputable name on arcade cabinets today.

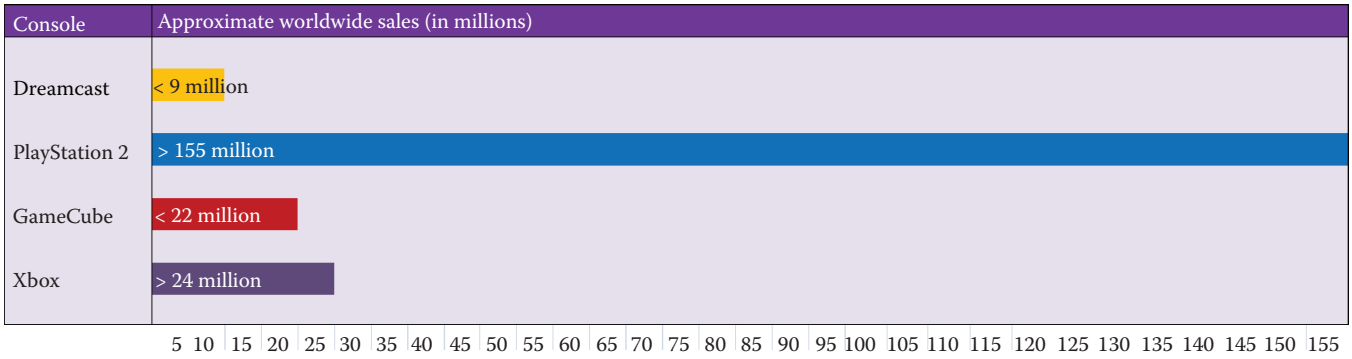
More than half a million PS2 consoles were sold the day of its Japanese launch, exceeding $250 million in sales when combined with software and peripherals—"more than double that of the Dreamcast's first-day total of $97 million" (IGN Staff, 2000b, p. 1). By 2005, Sony solidified its market dominance when the PS2 became the fastest game system to ship 100 million units worldwide. To date, the PlayStation 2 is the bestselling video game console of all time, with more than 155 million units sold (Figure 10.21).

By June 2003, both the GameCube and Xbox had a 13% market share—far behind the 60% market share of the PlayStation 2 (Frederick and Sekiguchi, 2003, para. 4). However even after a price drop to $99 that September, Nintendo would eventually land in a close third place in global console sales, just behind Xbox.

Beyond its lack of DVD playback, smaller game disc size, and next to no online gaming, other reasons for the GameCube's lower sales included less third-party support from certain developers and its image of being a system for younger gamers that was difficult for Nintendo to shake—even with its exclusive lineup of *Resident Evil* games. Furthermore, "CNN reported that Nintendo was charging a much higher licensing fee for GameCube ($11) while Microsoft and Sony charged ($7–$9)" (Rogers, 2014, p. 33).

The Xbox broke launch records in the United States when it sold 1.53 million units just three months after its North American debut (Orland, 2013, para. 9). By May 2006, the console had sold approximately 2 million more units than GameCube, but was a distant second place to the record-breaking PlayStation 2. While Microsoft may have sold more game consoles than Nintendo, it did so at a hefty cost. While it is not unusual for console manufacturers to sell their game systems at a loss (to recuperate later in software sales), "for every machine that Microsoft sold at $299 at the outset, it was losing about $126, thanks to the $425 cost of the machine" (Takahashi, 2011, p. 6). The Xbox may have been a huge financial loss for Microsoft—about $4 billion—however, it would it prove to be a valuable investment in the generations to come.

FIGURE 10.21 Sixth-generation console sales graph.



■ SIXTH-GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the sixth generation of video games. Here is a list of the top 10 features that defined the generation:

1. 128-bit microprocessors
2. Faster, more powerful CPUs (up to 733 MHz) and GPUs (up to 233 MHz)
3. Progressive scan and higher display resolutions (up to 720p and 1080i)
4. Greater RAM (up to 64 MB) and tens of millions of polygons per second
5. Digital versatile disc (DVD) format with DVD movie playback
6. Surround sound with higher audio sampling frequency (48 kHz)
7. Broadband Internet speed and online, multiplayer gaming on home consoles
8. Open world "sandbox" style games and first-person shooters break new ground
9. Cross-platform releases on both home console and PC
10. Game publisher mergers (such as Square Enix, Sega Sammy, and Bandai Namco)

■ ACTIVITY: PERFORMANCE OPTIONS

There were many new options made available for gamers during the sixth generation of home video game consoles. Many games could be played via LAN (local area network), online, or 2-player and even 4-player via split screen. For users with ED or HDTVs, numerous games could be played in progressive scan mode, which resulted in crisper, more colorful graphics and less screen blurring.

GUIDELINES

Obtain two HDTVs, two of the same sixth-generation consoles, system link cables, component cables, and some games that include: (1) progressive scan support and (2) multiplayer modes both via LAN and split screen. Since the online networks for these consoles have been discontinued, the LAN-supported games will offer a similar experience.

QUESTIONS

1. How do the graphics compare playing in progressive versus interlaced scan?
2. Describe the experience playing multiplayer games via split screen mode on one television versus playing on a LAN where each player has his or her own screen.

■ CHAPTER 10 QUIZ

1. Arcades declined in the United States for all of the following reasons, except:
   a. Arcade games became more expensive
   b. Console games became nearly equal in quality
   c. Not enough arcade games were being made
   d. Game rentals became more popular

2. Venues like Chuck E. Cheese's and Dave & Buster's have been successful from their:
   a. emphasis on food and beverage service
   b. inclusion of various redemption games
   c. super large screens, unique game controllers, and motion-controlled cabinets
   d. all of the above

3. Sega's Dreamcast began as two separate projects. In the end, the company went with:
   a. U.S. based project "Blackbelt" led by IBM veteran Tatsuo Yamamoto
   b. the internal "Katana" project by longtime Sega console designer Hideki Sato
   c. the "Emotion Engine" by Ken Kutaragi
   d. the "Gekko" CPU developed by computer giant IBM

4. Which format did Dreamcast use for its game media?
   a. CD-ROM (700 MB)
   b. GD-ROM (Gigabyte Disc, 1.2 GB)
   c. MiniDVD (1.5 GB)
   d. DVD (up to 8.5 GB)

5. This third-party developer decided not to develop games for the Dreamcast:
   a. Electronic Arts
   b. Capcom
   c. Namco
   d. Visual Concepts

6. The central processing unit for the PlayStation 2:
   a. 128-bit Hitachi SH-4 processor
   b. Intel Pentium III processor
   c. 128-bit "Emotion" RISC processor
   d. IBM Power PC "Gekko" processor

7. The PS2's CPU took some time for programmers to grasp, since it operated best in tandem with the console's:
   a. Nvidia NV2A GPU
   b. Flipper GPU
   c. Vector processing units (VPU0 and VPU1)
   d. None of the above

8. This compact, portable, friendly-looking system included a curved handle for easy carrying:
   a. Xbox
   b. GameCube
   c. PlayStation 2 Slim
   d. Dreamcast

9. Introduced the earliest first-party wireless controller with the WaveBird:
   a. Xbox
   b. GameCube
   c. PlayStation 2 Slim
   d. Dreamcast

10. Chose Toys "R" Us in the heart of Times Square for its launch party, handing out Krispy Kreme donuts as customers waited in line:
    a. Sega
    b. Sony
    c. Microsoft
    d. Nintendo

11. This console's version of cross-platform games typically looked sharper—often containing extra details such as lighting and bump mapping effects not included on the other systems:
    a. Sega Dreamcast
    b. Sony PlayStation 2
    c. Nintendo GameCube
    d. Microsoft Xbox

12. Which of the following features was *not* a characteristic of the Microsoft Xbox?
    a. Most powerful sixth-generation console powered by an Intel Pentium III processor
    b. Its GPU could run eight simultaneous effects layers to a polygon
    c. Built-in broadband port; set the standard for online gaming on home consoles
    d. Could download game patches and rip music CDs to its built-in hard drive

13. This console never fully realized the importance of online gaming:
    a. Nintendo GameCube
    b. Sega Dreamcast
    c. Sony PlayStation 2
    d. Microsoft Xbox

14. Which systems were incapable of DVD playback?
    a. PlayStation 2 and GameCube
    b. GameCube and Dreamcast
    c. Xbox and GameCube
    d. Dreamcast and PlayStation 2

15. This company acquired game developer Bungie Studios in June 2000.
    a. Sega
    b. Sony
    c. Microsoft
    d. Nintendo

16. Which game console totally dominated the generation in total number of units sold?
    a. Sega Dreamcast
    b. Microsoft Xbox
    c. Sony PlayStation 2
    d. Nintendo GameCube

True or False

17. An argument with Sega chairman Isao Okawa led to Sega of America president Bernie Stolar's termination from the company just a month before the Dreamcast's launch.

18. The Dreamcast included a built-in modem for connecting to the Internet.

19. One of the drawbacks of the PlayStation 2 was its inability to play DVD movies without an adapter.

20. The original Xbox suffered from poor initial sales because its original, first-party controller was far too small for the average gamer's hands.

■ FIGURES

FIGURE 10.1 *Dance Dance Revolution* (Konami, 1999). ("Dance Dance Revolution." Vintage Arcade Superstore, 2017. Retrieved from https://www.vintagearcade.net/shop/arcade-games/dance-dance-revolution-arcade-game/)

FIGURE 10.2 Screenshots of popular arcade games from 2000: (a) *Silent Scope 2: Dark Silhouette* (KCET/Konami, 2000), (b) *Marvel vs. Capcom 2* (Capcom, 2000), and (c) *18 Wheeler: American Pro Trucker* (Sega, 2000). (Silent Scope 2: Dark Silhouette courtesy of KCET/Konami, 2000; Marvel vs. Capcom 2 courtesy of Capcom,

2000; and 18 Wheeler: American Pro Trucker courtesy of Sega, 2000.)

FIGURE 10.3 Sega Dreamcast console and controller with LCD screen memory card. ("A North American Sega Dreamcast video game console," by Evan-Amos - own work, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=20590083. Retrieved from https://en.wikipedia.org/wiki/Dreamcast#/media/File:Dreamcast-Console-Set.png)

FIGURE 10.4 Screenshots of Dreamcast launch titles (a) *Sonic Adventure* (Sonic Team/Sega, 1999) and (b) *SoulCalibur* (Namco, 1999). (Sonic Adventure courtesy of Sonic Team/Sega, 1999; and SoulCalibur courtesy of Namco, 1999.)

FIGURE 10.5 Magazine advertisement for the Dreamcast in 1999. (From "Sega Dreamcast (9.9.99)" GamePro 120, July 1999, p. 95. IDG Publishing.)

FIGURE 10.6 Box art to five popular Dreamcast titles including: (a) to *Resident Evil – Code: Veronica* (NexTech/Capcom, 2000), (b) *NFL 2K1* (Visual Concepts/Sega, 2000), (b) *SoulCalibur* (Namco, 1999), (d) *Jet Grind Radio* (Smilebit/Sega, 2000), and (e) *Sonic Adventure* (Sonic Team/Sega, 1999). (Resident Evil – Code: Veronica courtesy of NexTech/Capcom, 2000; NFL 2K1 courtesy of Visual Concepts/Sega, 2000; SoulCalibur courtesy of Namco, 1999; Jet Grind Radio courtesy of Smilebit/Sega, 2000; and Sonic Adventure courtesy of Sonic Team/Sega, 1999.)

FIGURE 10.7 Sony PlayStation 2 with DualShock 2. ("An SCPH-30000 model with DualShock 2" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=12826957. Retrieved from https://en.wikipedia.org/wiki/PlayStation_2_models#/media/File:PS2-Fat-Console-Set.jpg)

Figure 10.8 Screenshots from PS2 launch titles (a) *SSX* (EA Sports Big, 2000) and *Tekken Tag Tournament* (Namco, 2000). (SSX courtesy of EA Sports Big, 2000; and Tekken Tag Tournament courtesy of Namco, 2000.)

FIGURE 10.9 Target Stores magazine advertisement for the Sony PlayStation 2 in 2000. (From *Electronic Gaming Monthly*, Issue 136, November 2000, page 13.)

FIGURE 10.10 Five defining PS2 titles: (a) *Metal Gear Solid 2: Sons of Liberty* (courtesy of KCEJ/Konami, 2001), (b) *Ratchet & Clank: Going Commando* (courtesy of Insomniac Games/SCEA, 2003), (c) *Grand Theft Auto III* (courtesy of DMA Design/Rockstar Games, 2001), (d) *God of War* (courtesy of SCE Santa Monica/SCEA, 2005), and (e) *Shadow of the Colossus* (courtesy of SCE Japan Studio/SCEA, 2005).

FIGURE 10.11 Game Boy Advance. ("The Game Boy Advance (GBA), a 32-bit handheld gaming system made by Nintendo and released in 2001." By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=18970777. Retrieved from https://en.wikipedia.org/wiki/Game_Boy_Advance#/media/File:Nintendo-Game-Boy-Advance-Purple-FL.jpg)

FIGURE 10.12 Box art to GBA hits (a) *Castlevania: Aria of Sorrow* (KCET/Konami, 2003), (b) *Metroid: Zero Mission* (Nintendo, 2004), (c) *WarioWare: Twisted!* (Nintendo, 2005), (d) *Pokémon Emerald Version* (Game Fream/Nintendo, 2005), and (e) *The Legend of Zelda: The Minish Cap* (Flagship/Nintendo, 2005). (Aria of Sorrow courtesy of KCET/Konami, 2003; Metroid: Zero Mission courtesy of Nintendo, 2004; WarioWare: Twisted! courtesy of Nintendo, 2005; Pokémon Emerald Version courtesy of Game Fream/Nintendo, 2005; and The Legend Of Zelda: The Minish Cap courtesy of Flagship/Nintendo, 2005.)

FIGURE 10.13 Nintendo GameCube console, controller, and one black memory card. ("A Nintendo GameCube console shown with memory card and a standard controller." By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=12836518. Retrieved from https://en.wikipedia.org/wiki/GameCube#/media/File:GameCube-Console-Set.png)

FIGURE 10.14 Screens of (a) *Luigi's Mansion* (Nintendo, 2001) and (b) *Star Wars Rogue Leader: Rogue Squadron II* (Factor 5/LucasArts, 2001) by Wardyga. (Luigi's Mansion courtesy of Nintendo, 2001; and Star Wars Rogue Leader: Rogue Squadron II courtesy of Factor 5/LucasArts, 2001.)

FIGURE 10.15 Magazine advertisement for GameCube title *Super Mario Sunshine* in 2002. ("Super Mario Sunshine PRINT AD video game Nintendo GameCube advertisement 2002" posted by Rick Obee on November 22, 2016. Retrieved from http://addio.ecrater.com/p/13765408/super-mario-sunshine-print-ad)

Figure 10.16 Box art to five defining GameCube titles including: (a) *Super Smash Bros. Melee* (HAL Labs/Nintendo, 2001), (b) *Metroid Prime* (Retro Studios/Nintendo, 2002), (c) *The Legend of Zelda: The Wind Waker* (Nintendo, 2003), (d) *Eternal Darkness* (Silicon Knights/Nintendo, 2002), and (e) *Resident Evil 4* (Capcom, 2005).

Super Smash Bros. Melee courtesy of HAL Labs/Nintendo, 2001; Metroid Prime courtesy of Retro Studios/Nintendo, 2002; The Legend of Zelda: The Wind Waker courtesy of Nintendo, 2003; Eternal Darkness courtesy of Silicon Knights/Nintendo, 2002; and Resident Evil 4 courtesy of Capcom, 2005.)

FIGURE 10.17 Microsoft Xbox console with a "Controller S" model controller. ("Xbox console with 'Controller S'" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11333075. Retrieved from https://en.wikipedia.org/wiki/Xbox_(console)#/media/File:Xbox-console.jpg)

FIGURE 10.18 Screens of Xbox launch titles (a) *Halo: Combat Evolved* and (b) *Madden NFL 2002* (Bungie/Microsoft Game Studios, 2001) (EA Sports, 2001) by Wardyga. (EA Sports, 2001, and Halo: Combat Evolved (Bungie/Microsoft Game Studios, 2001.)

FIGURE 10.19 2001 Xbox ad featuring characters from *Tony Hawk's Pro Skater 2*, Abe from *Oddworld: Munch's Oddysee*, and the original "Duke" controller. ("Early Xbox Marketing – 2" posted November 15, 2001 by Microsoft. Retrieved from https://news.microsoft.com/early-xbox-marketing-2/#d7wgjIlOSVSctmmQ.99)

FIGURE 10.20 Xbox hits: (a) *Star Wars: Knights of the Old Republic* (BioWare/LucasArts, 2003), (b) *Burnout 3: Takedown* (Criterion Games/Electronic Arts, 2004), (a) *Halo: Combat Evolved* (Bungie/Microsoft Game Studios, 2001), (b) *Tom Clancy's Splinter Cell: Chaos Theory* (Ubisoft Montreal/Ubisoft, 2005), and (c) *Ninja Gaiden Black* (Team Ninja/Tecmo, 2005). (Star Wars: Knights of the Old Republic courtesy of BioWare/LucasArts, 2003; Burnout 3: Takedown courtesy of Criterion Games/Electronic Arts, 2004; Halo: Combat Evolved courtesy of Bungie/Microsoft Game Studios, 2001; Tom Clancy's Splinter Cell: Chaos Theory courtesy of Ubisoft Montreal/Ubisoft, 2005; and Ninja Gaiden Black courtesy of Team Ninja/Tecmo, 2005.)

FIGURE 10.21 Sixth-generation console sales graph. (Designed by Wardyga using data from Resource Site for Video Game Research, "Console Wars through the Generations." Available at http://dh101.humanities.ucla.edu/DH101Fall12Lab4/graph—console-wars and GamePro. "The 10 Worst-Selling Consoles of All Time." Retrieved from http://www.gamepro.com/gamepro/domestic/games/features/111822.shtml)

Pro File: Ken Kutaragi. Photo credit: Ken Kutaragi receiving a Lifetime Achievement Award at the Game Developers Choice Awards 2014. Retrieved from https://en.wikipedia.org/wiki/Ken_Kutaragi#/media/File:Ken_Kutaragi_-_Game_Developers_Choice_Awards_2014_(cropped).jpg.

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The Rise of PC Gaming

OBJECTIVES

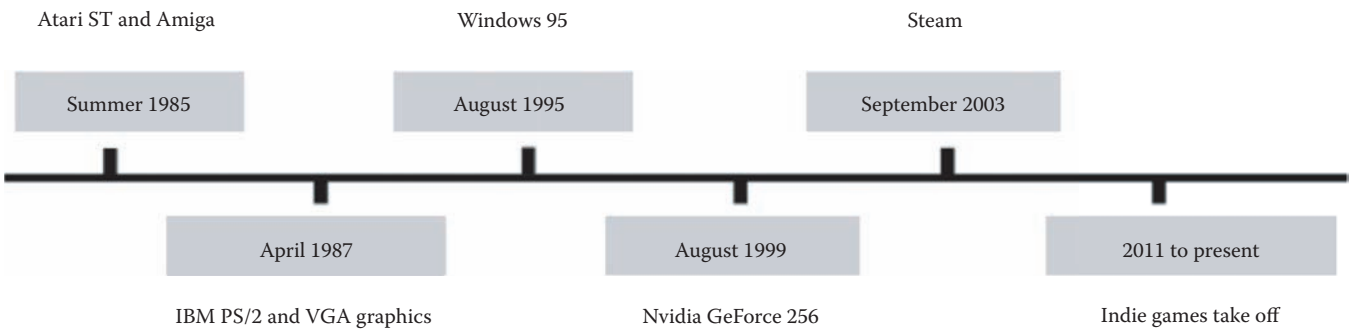
After reading this chapter, you should be able to:

- Provide an overview Apple, Atari, and Commodore's evolution into the 1990s.
- Explain how IBM revolutionized the personal computer business.
- Talk about Microsoft and the contribution Windows made to gaming.
- Be familiar with key technological breakthroughs in personal computers.
- Have a sense of graphics and capabilities of PC games as they evolved up to now.
- Discuss online gaming and its influence on the style or direction of certain games.
- Review the history of Steam and its developments leading up to today.
- Recognize how PC gaming is different from home console gaming.
- List some of the key video game titles by genre released on personal computer.
- Describe the influence of PC gaming on the rest of the video game market.
- Explain several innovations introduced to gaming by the computer platform.
- Reflect on the positive and negative aspects of virtual online worlds.
- Summarize key personal computer gaming market sales and trends.

■ KEY TERMS AND PEOPLE

3D accelerator
3dfx
Achievements
Adobe Flash
AGA
Daisuke Amaya
Amiga series
API
Apple
Atari ST series
ATI
Avatar
Bethesda
BioWare
Blizzard Entertainment
Bugs
CAD
Anshe Chung
Jess Cliffe
Cloud gaming
Commodore
Compaq
Deathmatch
Direct3D
DirectX
DOS/MS-DOS
EGA
Craig Eisler
Eric Engstrom
Epic Games
Episodic gaming
eSports
F2P
Farming
Charles R. Flint
Full motion video
First-person shooter
Freemium
Richard Garriot
Garry's Mod
GeForce 256
Genlock
GPU
Ailin Graef
GUI
HTC Vive
IBM clones
IBM/5150
id Software
iMac
Indie games
Internet
Jon Jacobs
Java
Steve Jobs
JTS
Minh Le
Linden Lab
Linux
Lotus 1-2-3
Macintosh
Matchmaking
Micro-transactions
MIDI
Jay Miner
MMORPG
MMOW
Modding
Mojang
Multiplayer
NCsoft
Neverdie
Nvidia
Oculus Rift
OpenGL
OS X & OS/2
Hewlett Packard
Patches
PC/AT
PC-compatible
PCjr
Personal Computer
Radeon
RTS
Samsung Gear VR
Shareware
Sony Online Entertainment
Sound Card
SoundBlaster
Alex St. John
Steam
Telltale Games
Twitch
Unreal Engine
Valve
Virtual item
Virtual worlds
Virtual Reality
Voodoo
Windows OS
Workbench
Will Wright
Yamaha YM3812
YouTube

■ COMPUTER MILESTONES TIMELINE



■ INTRODUCTION

This chapter reviews the rise of PC gaming and the many technological developments that helped shape the computer gaming landscape to what it is today. Coverage includes the end of computer offerings from **Atari** and **Commodore**, to changes at **Apple** and the rise of the PC-compatibles, to recent developments in PC gaming today. Breakthroughs throughout the evolution of PC gaming are also discussed, as well as the people behind the scenes and the popular game titles synonymous with each era.

■ END OF AN ERA

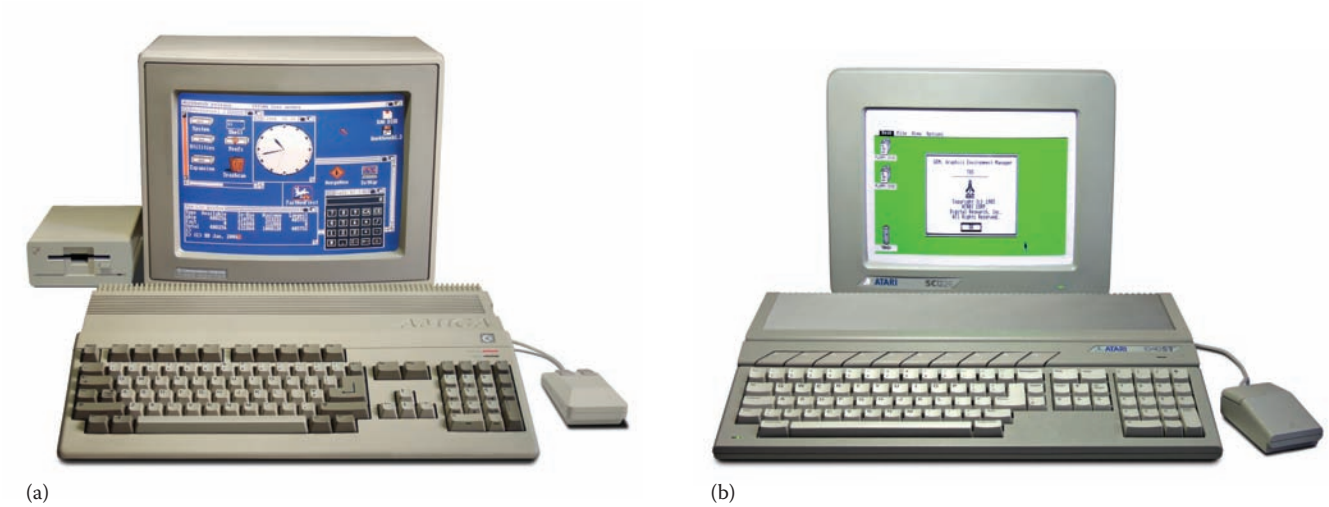
The 8-bit line of computers by Apple, Atari, and Commodore were succeeded by more powerful offerings from each company in the mid-1980s. Apple led the way with its monochrome, 32-bit **Macintosh** home computer in January 1984. It was the company's first mass-market PC to include a **graphical user interface (GUI)** and mouse (Polsson, 2009). The GUI provided users with graphical icons and other visual information they could interact with more easily by using a mouse—as opposed to being limited to a strictly text-based user interface and keyboard commands. On the other hand, the first three Macintosh computers lacked color graphics.

The **Atari ST** (Figure 11.1a) line of home computers debuted around June 1985. It contained both 16- and 32-bit architecture where the "ST" stood for "Sixteen/Thirty-two" since its Motorola 68000 was a 32-bit processor that communicated through a 16-bit bus (Reese, 1989, para. 2). Following on the footsteps of the ST was the launch of Commodore's **Amiga** (Figure 11.1b) family of personal computers in July 1985; however, the system was not widely available until early 1986 due to production problems. Like the Atari ST computers, the Amiga also ran on the 16- and 32-bit Motorola 68000 series of microprocessors. Atari and Amiga's systems retailed for over $1,000 with color monitors, while the Macintosh home computer cost twice as much.

It was around this time that the term "**personal computer**" became popular and most computer companies began avoiding the term "home computer." An article by *Compute!* Magazine explained that home computers had developed a connotation of being low-end machines primarily used for playing video games. Apple's John Sculley flat out denied that his company was selling home computers, instead referring to them as "computers for use in the home" (Halfhill, 1986, p. 38). Apple's stance on being a more costly, sophisticated machine may have contributed to the Atari ST and Commodore Amiga becoming the dominant gaming computers throughout the end of the 1980s.

While the ST and Amiga began a new era of computer gaming, their high price tags held many gamers and developers back on the older 8-bit systems until prices came down later in the decade. Aside from gaming, the Atari ST became the popular platform for audio production due to its built-in **MIDI (Musical Instrument Digital Interface)** ports, while Amiga became a prominent computer for video production applications like *Video Toaster*. Its **genlock** ability allowed the Amiga to

FIGURE 11.1 Atari ST (a) and Commodore Amiga 500 (b) with peripherals.



(a) (b)

match the refresh rate of incoming video signals, while the computer's transparency setting provided the ability to display graphics over video. Popular games around this time included action platformers such as *Turrican* and *Zool*, RPG and adventure games (see Figure 11.2), space shooters like *Battle Squadron* and *Xenon 2: Megablast*, and strategy games such as *Lemmings*.

After co-founding the company and helping pioneer the home computer market, "**Steve Jobs** [was] exiled from Apple in 1985 because of poor sales of the original Macintosh" (Reimer, 2005, p. 7). Apple released subsequent systems in the Macintosh family, including the **Macintosh Plus** in 1986 and a return to color graphics with the $5,500 **Macintosh II** in 1987. These systems were followed by the Macintosh "**Classic**" series in the early 1990s, with the original Classic being the first Mac under $1,000.

The ST was followed by the **Atari STE** (E for "enhanced") in 1989, the **Atari TT** ("Thirty-two/Thirty-two") in 1990, with the final ST computer being the **Atari MEGA STE** in 1991. Atari would release one last computer with the **Falcon** in 1992, before focusing its efforts back on the home console market with its Jaguar console in 1993.

The original **Amiga 1000** would be succeeded by no less than 10 subsequent models and/or upgrades, from the best-selling **Amiga 500** in 1987 (Figure 11.3), to the **A1200** and **A4000** released in late 1992 (see Table 11.1). Like Atari, Commodore would make a last-ditch effort on the home console market when it released the 32-bit Amiga **CD32** in Europe, Canada, Australia, and Brazil in 1993. Even though the Amiga consistently outsold the ST, the CD32 was a market failure and the company went bankrupt in April 1994.

HEAD-TO-HEAD

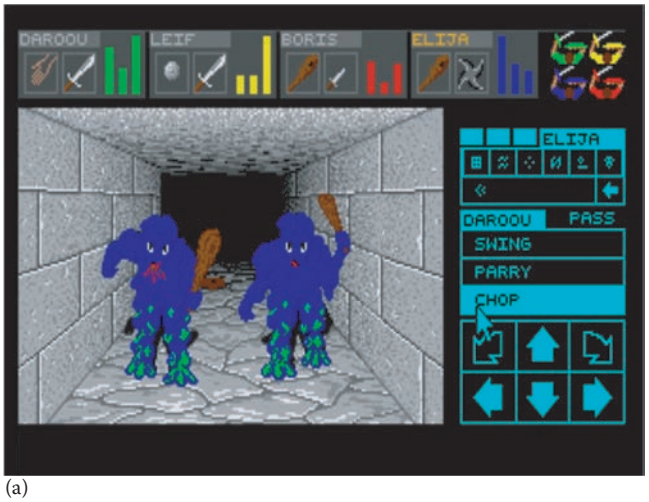
To compare the graphics and sound between the Atari ST and Commodore Amiga, try some games released on both systems. Some games to compare include *Shadow of the Beast, Speedball 2: Brutal Deluxe*, and *The Secret of Monkey Island*.

■ IBM AND THE RISE OF THE CLONES

In 1985, Bill Gates predicted "the advent of inexpensive, 100%-compatible clone computers that was propelling the PC ahead, and that any defects in the design of the computer would eventually be remedied by the combined force of the many companies selling PCs and PC add-on products, such as new graphics cards" (Reimer, 2005, p. 6). As an early supporter of the Macintosh computer, Gates even reached out to Apple with a plan to license their technology to other companies—a proposal that Apple would reject. Gates' prediction came true and a different company would lead the evolution of personal computers into the next decade.

IBM (International Business Machines Corporation) began operation in Endicott, NY as the Computing-Tabulating-Recording Company (CTR) when **Charles**

FIGURE 11.2 Screenshots of popular computer titles: *Dungeon Master* (a, on the Atari ST) and *The Secret of Monkey Island* (b, on the Amiga 500).



(a)

(b)

FIGURE 11.3 Print advertisement for the Commodore Amiga 500 in 1987.

TABLE 11.1 Commodore Amiga Computer Series Releases

Model	Release	Description
A1000	1985	By Atari 800 creator **Jay Miner**; Motorola MC68000 (7.16 MHz) CPU and3 co-processors; 256kB RAM (to 512kB); separate keyboard
A2000	1987	High-end 512kB–1Mb RAM; UK-only **A1500** with extra floppy drive; **A2000/HD** had built-in hard disk and controller; also **A2500** model
A500	1987	Most popular Amiga; debuted at $699; 512kB expandable RAM; keyboard/computer were a single unit; had **CDTV** and **500+** model
A3000	1990	Second generation Amiga; high-end workstation with 16–25 MHz Motorola MC68030; 2 Mb RAM (upgradable to 18 Mb); **Enhanced Chip Set** (ECS) and **Kickstart/Workbench 2**OS
A600	1992	Smallest Amiga made; redesign of A500+ but had incompatibility problems; was replaced by the equally priced A1200 the same year
A4000	1992	Third-generation Amiga; Motorola MC68EC030 (25 MHz); 2 Mb–16 Mb RAM; **Advanced Graphics Architecture (AGA)** chipset allowed 256,000 out of 16.8 million colors on-screen; **Workbench 3** OS
A1200	1992	Priced at $599; a stronger A500 successor than the A600 with AGA chipset; Motorola MC68EC020 (14.32 MHz) + **FPU**; 2–10 Mb RAM

Ranlett Flint led the consolidation of four major companies in 1911. The merger included companies by **Alexander Dey** (inventor of the dial recorder), **Herman Hollerith** (who patented the Electric Tabulating Machine), **Julius E. Pitrat** (who patented the computing scale in 1885), and Bundy Manufacturing Company whose co-founder **Willard Bundy** invented the employee time clock. IBM began as a machinery manufacturer and in 1937 the company was hired by the U.S. government for its tabulating equipment to maintain 26 million employment records in accordance with the Social Security Act. As the company (eventually nicknamed "Big Blue") continued to grow, IBM's support extended from mainframe computers to space exploration and even nanotechnology.

The company entered the PC market with the **IBM 5150** (Figure 11.4) in 1981 and the home market with **PCjr** in 1984. IBMs did not become a viable gaming platform until the 16-bit **PC/AT** ("Advanced Technology") computers in 1984. Advancements such as **EGA (Enhanced Graphics Adapter)** display allowed for more on-screen colors (16 from a palette of 64) and higher graphics resolution (up to 640 × 350 pixels); however, early IBM PCs lacked the graphics and sound power of the Atari ST and Amiga systems. Additionally, the high cost of IBM and **PC-compatible** systems (known as **IBM clones**) deterred many gamers through much of the 1980s. It was IBM's spreadsheet application **Lotus 1-2-3** that helped drive initial sales of the computers in the business sector.

DID YOU KNOW?

Compaq (**Comp**atibility **A**nd **Q**uality) was first to legally reverse engineer the IBM PC and "by the late 1990s and early 2000s, Compaq was the largest PC manufacturer in the world, before it was absorbed by **Hewlett Packard"** (McCullough, 2014).

As its market share increased and IBM became the dominant name in personal computers, the price of IBM PCs and clones became more affordable. The immense

FIGURE 11.4 IBM PC 5150 magazine advertisement from 1982.

"My own IBM computer. Imagine that."

One nice thing about having your own IBM Personal Computer is that it's *yours*. For your business, your project, your department, your class, your family and, indeed, for yourself.

Of course, you might have thought owning a computer was too expensive. But now you can relax.

The IBM Personal Computer starts at less than $1,600† for a system that, with the addition of one simple device, hooks up to your home TV and uses your audio cassette recorder.

You might also have thought running a computer was too difficult. But you can relax again.

Getting started is easier than you might think, because IBM has structured the learning process for you. Our literature is in *your* language, not in "computerese." Our software *involves* you, the system *interacts* with you as if it was made to—and it was.

That's why you can be running programs in just one day. Maybe even writing your *own* programs in a matter of weeks.

For ease of use, flexibility and performance, no other personal computer offers as many advanced capabilities. (See the box.)

But what makes the IBM Personal Computer a truly useful tool are software programs selected by IBM's Personal Computer Software Publishing Department. You can have programs in business, professional, word processing, computer language, personal and entertainment categories.

You can see the system and the software in action at any ComputerLand® store or Sears Business Systems Center. Or try it out at one of our IBM Product Centers. The IBM Data Processing Division will serve those customers who want to purchase in quantity.

Your IBM Personal Computer. Once you start working with it, you'll discover more than the answers and solutions you seek: you'll discover that getting there is half the fun. Imagine that.

IBM PERSONAL COMPUTER SPECIFICATIONS
*ADVANCED FEATURES FOR PERSONAL COMPUTERS

User Memory
16K - 256K bytes*
Permanent Memory
(ROM) 40K bytes*
Microprocessor
High speed, 8088*
Auxiliary Memory
2 optional internal diskette drives, 5¼", 160K bytes per diskette
Keyboard
83 keys, 6 ft. cord attaches to system unit*
10 function keys*
10-key numeric pad
Tactile feedback*

Display Screen
High-resolution (720h x 350v)*
80 characters x 25 lines
Upper and lower case
Green phosphor screen*
Diagnostics
Power-on self testing*
Parity checking*
Languages
BASIC, Pascal
Printer
Bidirectional*
80 characters/second
12 character styles, up to 132 characters/line*
9 x 9 character matrix*

Color/Graphics
Text mode:
16 colors*
256 characters and symbols in ROM*
Graphics mode:
4-color resolution: 320h x 200v*
Black & white resolution: 640h x 200v*
Simultaneous graphics & text capability*
Communications
RS-232-C interface
Asynchronous (start/stop) protocol
Up to 9600 bits per second

The IBM Personal Computer and me.

†This price applies to IBM Product Centers. Prices may vary at other stores.

For the IBM Personal Computer dealer nearest you, call (800) 447-4700. In Illinois, (800) 322-4400. In Alaska or Hawaii, (800) 447-0890.

market share of the PC attracted game developers around 1987, which was the year that much-improved **VGA (Video Graphics Array)** displays on the new **IBM PS/2** and FM synthesis **sound cards** (like Ad Lib's **Yamaha YM3812**) became widely available.

■ GAMING IN DOS

PC games at this time ran on **DOS (disk operating system)**. There were many types of DOS, but it was Microsoft's **MS-DOS** (Figure 11.5) that dominated IBM and PC-compatible systems. After booting up the computer, a DOS command prompt would appear on the screen. The user then had to enter a series of commands to launch a program—and only one program could be launched at a time, which took up the entire screen.

Games typically had to be configured (for resolution, sound, etc.) prior to playing to allow DOS programs direct access to the computer's hardware. For a DOS game to use Creative Technology's **SoundBlaster** card (released in 1989) to output sound, it had to support that hardware directly. In other words, the game developer would need to program support for every major sound card so the user could select their card on the configuration screen (Hoffman, 2014, para. 14). This same scenario applied to peripheral devices such as game controllers. Microsoft's popular **Windows 3.0** (1990) made playing games like *Solitaire* easier to open; however, more complex games still required MS-DOS.

■ GENRE PIONEERS: EARLY 1990s

The early 1990s brought about a number of revolutionary games that began on the personal computer. *The Secret of Monkey Island* (1990) set the standard for graphical adventure games; *Civilization* (1991) became one of the most influential turn-based strategy games; and then *Dune II* revolutionized **real-time strategy (RTS)** games in 1992. *Ultima Underworld: The Stygian Abyss* (1992) is regarded for its 3D world and sloped surfaces. Its "complex levels and the immersion of its dungeon environment were both unparalleled in any game" (PC Gamer, 2016, p. 4). Also that year, *Alone in the Dark*'s puzzles and camera views would influence the yet unnamed "survival horror" genre.

id Software's *Wolfenstein 3D* (1992) advanced **first-person shooter (FPS)** games with its super smooth movement, paving the way for the genre-defining *Doom* in 1993. In addition to promoting networked **multiplayer** gaming, *Doom* introduced the concept of the "**deathmatch**" where the object is to kill or "frag" as many other players as possible until a time limit or other condition is reached. id Software also popularized the **shareware** distribution method (i.e., giving away the first level[s] of a game to entice gamers into purchasing the full release), as well as **modding** (slang for "modifying") where users could change entire attributes of the game such as textures and characters.

That same year *Frontier: Elite 2* provided an entire universe to explore, while the gorgeous environments and sounds of bestsellers *Myst* and *The 7th Guest* (Figure 11.6) showcased what the newer **CD-ROM** media was truly capable of delivering. Notable titles from 1994 included *Wing Commander III: Heart of the Tiger*, known for its narrative and **full motion video (FMV)**; *X-COM: UFO Defense*, which transformed the strategy genre with its turn-based tactical action; and first-person, action RPG *System Shock*, which broke new ground with its 3D engine, physics simulation, and multifaceted gameplay.

Even with these revolutionary titles being born on the PC platform, the enormous success of the home console market (particularly the Nintendo Entertainment System) was believed to have taken a toll on the PC

FIGURE 11.5 A look at the MS-DOS prompt screen.

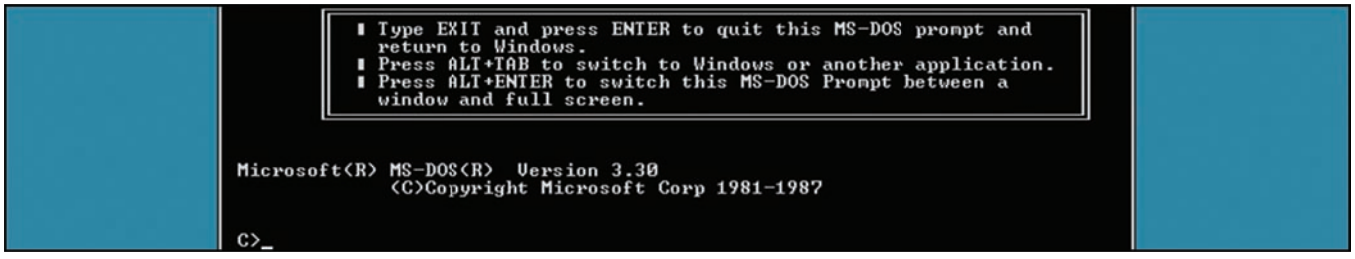


FIGURE 11.6 Screenshots from popular early 1990s PC titles: (a) *Myst* and (b) *The 7th Guest.*

(a)

(b)

gaming industry by the early 1990s. In 1993, ASCII Entertainment Software's Alan Chaplin reported that the market for home console games had reached $5.9 billion in revenue—12 times that of the computer gaming market's $430 million (Wilson, 1993, p. 98). The computer gaming industry needed a boost, and it would find it with the next operating system from Microsoft.

■ WINDOWS 95 AND THE MID-1990s

Two major PC operating systems introduced to compete with MS-DOS included the free and open-source **Linux** in 1991 and IBM's **OS/2 2.0** released in 1992. While these platforms were adopted by millions of users, it was Microsoft's **Windows 95** that would become the mainstream OS that both the general public, as well as game developers, would crown king. The launch of Windows 95 on August 24, 1995 was a huge media event where people lined up in droves to be among the first to receive the new software at midnight. "*Tonight Show* host Jay Leno emceed the launch party, with 'Start Me Up' by The Rolling Stones playing as the official theme song of the event" (Reimer, 2005, p. 8).

Where DOS allowed direct access to hardware and system components, Windows 95 used a more protected memory model that restricted user access to these areas. To provide a solution for programmers to develop great games and other multimedia on the OS, Microsoft included a set of **application programming interfaces** (**APIs**) known as **DirectX**. DirectX was created by development lead **Craig Eisler**, **Alex St. John**, and program manager **Eric Engstrom**. Unlike in DOS, high-quality Windows 95 games could be played "without leaving the Windows environment, making computer game installation suddenly easier" (Kent, 2001, p. 519).

Use of the **Internet** became increasingly popular with consumers during this time and the popularity of online gaming would quickly follow. **3D accelerator cards** such as **3dfx Interactive**'s **Voodoo** chipset (1996) became more affordable, resulting in more detailed 3D graphics. That year *Tomb Raider* (Figure 11.7) revolutionized third-person 3D exploration and introduced the world to **Laura Croft**; *Quake* (Figure 11.8a) pioneered online FPS multiplayer with its "Quakeworld" update; and *Diablo* took action RPGs to new heights with its randomly generated dungeons, fast action, items variety, and immersive atmosphere. In 1997, Origin Systems released *Ultima Online*, which provided an entire virtual world to explore for a monthly fee. Creator **Richard Garriott** coined the term "**Massively Multiplayer Online Role-Playing Game**" **(MMORPG)** and a new genre was born.

■ LATE 1990s

By the late 1990s, APIs like DirectX, **OpenGL** by **Silicon Graphics**, and later Microsoft's **Direct3D**, would mature and eliminate the need for proprietary interfaces. This, in turn, led to rapid development of 3D gaming technology over the next few years. MS-DOS would be discontinued shortly after the decade and online gaming became increasingly popular. Other developments like web browser plug-ins such as **Sun Microsystems' Java** and **Adobe Flash** became common platforms for simple browser-based games.

FIGURE 11.7 Two-page magazine advertisement for *Tomb Raider* in 1996.

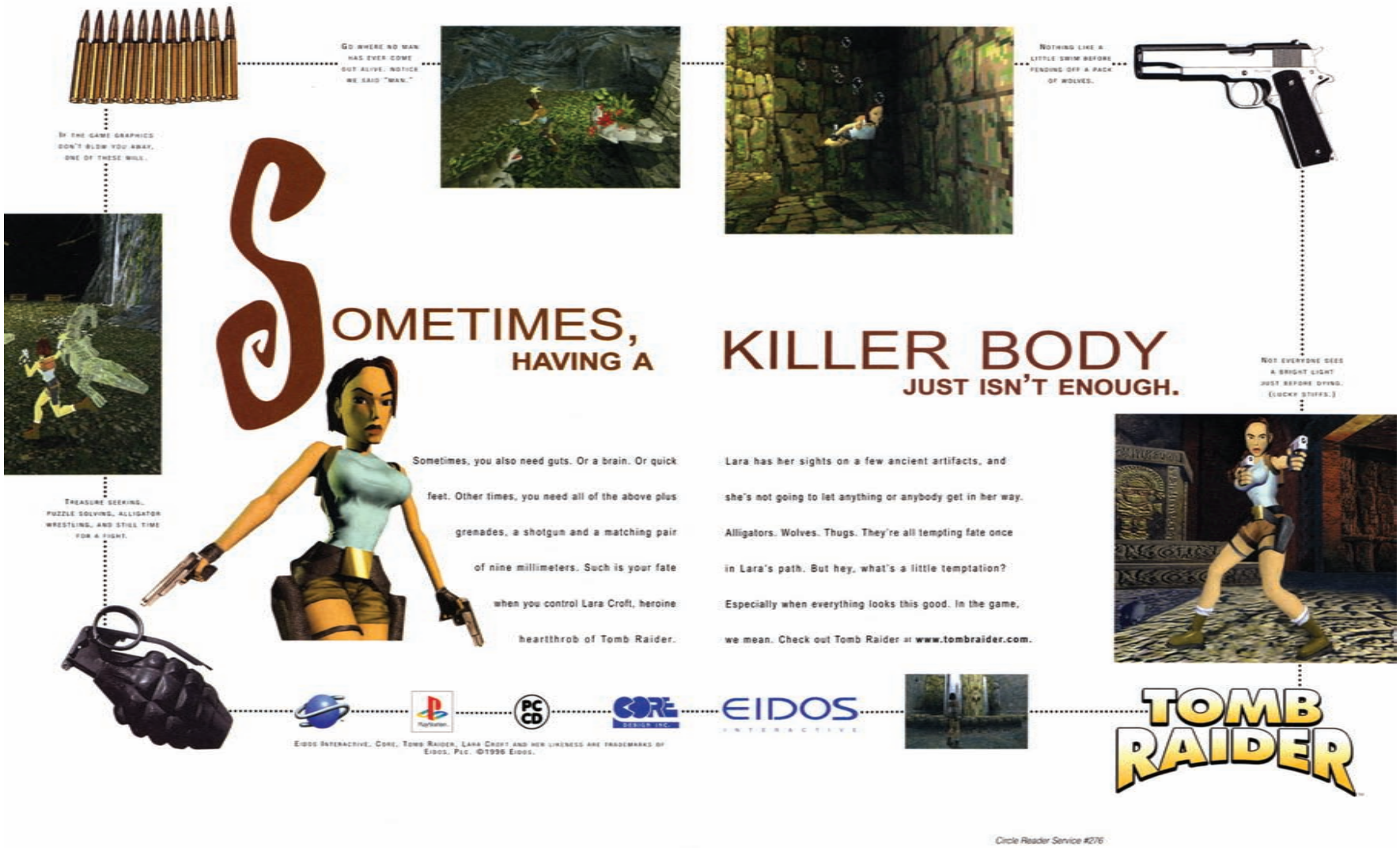


FIGURE 11.8 Screenshots from popular mid-1990s PC titles: (a) *Quake* and (b) *Ultima Online*.

(a)

(b)

One genre that saw explosive growth in the late 1990s was real-time strategy (see Table 11.2). Unlike in early turn-based strategy games, RTS games take place in real time, requiring the player to perform numerous, often complex functions where speed is a major factor. The frantic gameplay in titles such as *Age of Empires* (1997) and *StarCraft* (1998) made these games especially fun to watch, with the latter helping establish the **eSports** industry beginning in South Korea. The genre became synonymous with PC gaming due to its multitude of commands requiring a keyboard and the precision needed from a mouse.

Another pivotal PC title included *Half-Life* (1998) (Figure 11.9a) with its "then-revolutionary use of scripted events that propelled the action forward without ever removing [the player] from the game. It was the first shooter with a completely seamless presentation from beginning to end: No levels, no loading screens, no cutscenes—just one long take from beginning to end" (PC Gamer, 2016, p. 7). Also that year *Starsiege: Tribes* was among the first multiplayer-only games; *Thief: The Dark Project* advanced the "stealth game" genre on PC; and *Baldur's Gate* put Canadian developer **BioWare** on the map—who would become one of the most renowned action RPG developers in the industry.

Many popular MMORPGs soon followed, and 1999 was an exceptional year with **Sony Online Entertainment**'s *EverQuest* (Figure 11.9b) in March and Turbine's *Asheron's Call* in November. Both games offered 3D worlds which many considered even more immersive than the isometric view in *Ultima Online* (Figure 11.8b). Like *Ultima Online*, these games were "pay-to-play" although *EverQuest* also used the "**freemium**" strategy of offering the game free-to-play [**F2P**], but charging players for particular features or functionality (Schenck, 2011, para. 2). *Ultima Online, EverQuest*, and *Asheron's Call* have collectively been referred to as the "Big Three" MMORPGs of the early era due to their influence on popularizing the genre in the West (Ivory, 2012, p. 15).

Before the decade ended, the *Unreal* first-person shooter franchise would make a name for itself with *Unreal* in 1998 and *Unreal Tournament* in 1999. The game's **Unreal Engine** gained prominence when U.S. developer **Epic Games** began licensing it to other com-

TABLE 11.2 Real-Time Strategy Pioneers

Developer	Country	Game Series
Blizzard Entertainment	United States (CA)	Warcraft, StarCraft
The Creative Assembly	United Kingdom	Total War
Ensemble Studios	United States (TX)	Age of Empires
Relic Entertainment	Canada (Vancouver)	Homeworld, Company of Heroes
Westwood Studios	United States (NV)	Command and Conquer

FIGURE 11.9 Screenshots of late 1990s hit titles: (a) *Half-Life* (1998) and (b) *EverQuest* (1999).

(a)

(b)

panies to build games on. Then **Minh Le** and **Jess Cliffe** released a first-person multiplayer mod for *Half-Life* called *Counter-Strike*. *Half-Life* developer **Valve** hired the two men and acquired the game's intellectual property, resulting in numerous sequels and spinoffs. The decade ended with FPS hits *System Shock 2* and *Quake III Arena*.

PC technology took a step further when **Nvidia** released the **GeForce 256** near the turn of the century. Called the world's first **GPU** or **graphics processing unit**, this 256-bit 3D processor offered innovations in geometric polygons, dynamic lighting effects, as well as advanced textures and blending abilities (Nvida, 1999, p. 1). The integrated features of the GeForce 256 distinguished it from older 3D accelerators that took power from the main processor, freeing up the computer's CPU and making 3D development easier than older **computer-aided design (CAD).** GPUs also helped make PC hardware more affordable. The following year, Vooodoo graphics chip manufacturer 3dfx filed for bankruptcy and was acquired by Nvidia. A new rivalry would ensue between Nvidia with its GeForce product line and **ATI Technologies** with its **Radeon** graphics chips.

Apple began to decline during the mid 1990s and in December 1996 Steve Jobs reacquired the company for $400 million. The company's financial losses allowed Jobs to regain control of the company as CEO where he would achieve some of his greatest goals. In addition to saving the company, the colorful line of all-in-one **iMac** computers (monitors with built-in hard drives, etc.) in 1998 "revived Apple's fortunes, and with Mac **OS X** [Operating System X] on the horizon, the Macintosh enjoyed a bump in sales to 3.8 million units in both 1999 and 2000" (Reimer, 2005, p. 8).

■ THE NEW MILLENNIUM OF PC GAMING

Microsoft released **Windows XP** in 2001, which combined the solid performance of its corporate Windows NT with the user-friendliness of Microsoft's home versions. Apple released its tenth operating system that year with OS X. Sales remained flat for Macintosh computers, until "the release and overwhelming sales success of the **iPod** in 2001, [when] positive buzz began surrounding Apple again and Macintosh sales started to creep up again in late 2004 … despite the PC and Windows gaining a completely dominant 97% market share" (Reimer, 2005, p. 9).

The popularity of PC gaming continued into the new millennium, although many developers began shifting their focus to home consoles which had a larger user base and were arguably easier to develop for. One of the factors that can make PC game development more complex is that a PC game's performance depends on the graphic capabilities of a player's hardware. To make a computer game that is compatible on as many systems as possible, developers have to program computer games to run at numerous resolutions and qualities. By contrast, home consoles have traditionally provided a level of standardization where developers basically only have to program one version of the game per platform.

TABLE 11.3 Popular MMORPGs in the New Millennium by Year

Year	Game (Developer and Location)	Type
2001	RuneScape (Jagex, England)	Free-to-Play; Freemium
2002	Ragnarok Online (Gravity, Korea)	Freemium; and Pay-to-play
2003	EVE Online (CCP Games, Iceland)	Freemium
2004	World of Warcraft (Blizzard, CA)	Pay-to-play; Free to level 20
2005	Guild Wars (ArenaNet, WA)	Free-to-play with purchase
2006	Dungeons & Dragons Online (Turbine, MA)	Freemium
2007	Lord of the Rings Online (Turbine, MA)	Freemium
2008	Warhammer Online: Age of Reckoning (EA, CA)	Freemium
2009	Champions Online (Cryptic Studios, CA)	Free-to-play; Freemium
2010	Final Fantasy XIV (Square Enix, Japan)	Pay-to-play; 30-day trial

Furthermore, it is highly impracticable to test a PC game on every possible combination of hardware and configuration, meaning that game **bugs** (glitches) are inevitable. This leads to the further work of developing downloadable **patches** (fixes) for PC games. On the flip side, playing a PC game 3 feet away from a computer monitor (often with a keyboard and mouse) provides a very different (somewhat more intimate) experience than playing on a home console and the PC has remained the central platform for strategy, simulation, and online role-playing games for this reason.

Important games in the early part of the twenty-first century included *Deus Ex* (2000) for combining action role-playing with an emphasis on the freedom of choice, along with first-person shooting and elements of stealth. *The Elder Scrolls III: Morrowind* (2002) also provided the player with an unprecedented amount of choice in its open world and established Rockville, Maryland's **Bethesda** as a leader in these types of games. The year 2003 saw the release of *DotA (Defense of the Ancients)*, which began as a mod for *Warcraft III* and pioneered what would be known as the **Multiplayer Online Battle Arena (MOBA)** genre years later. That same year saw the release of Icelandic developer CCP Games' *EVE Online*, an unscripted MMORPG universe with 7800 star systems for players to visit as they essentially create their own experience.

One publisher/developer who would become legendary in the PC community throughout the 2000s was the California-based **Blizzard Entertainment**. In addition to successful sequels to its classic *Diablo* and *Star Craft* franchises, the company broke new records with the release of *World of Warcraft (WoW)* in 2004. *WoW* grew to become the world's most-subscribed-to MMORPG of all time, obtaining more than 12 million subscriptions by 2010 (McDougall, 2010, para. 1). See Table 11.3 for other popular MMORPGs released before and after *WoW*.

■ STEAM AND INDIE GAMES

On September 12, 2003, *Half-Life* developer Valve released a new digital distribution platform called **Steam**. Steam is unique in that it provides both large and small game companies a central platform to sell games and for users to download updates and patches. Developers have free access to the "Steamworks" API, which they can use to integrate a variety of features—from networking and **matchmaking** (pairing gamers with similar skill sets to play together)—to **microtransactions** (collecting additional money for game features or items) and parameters for in-game **achievements** (trophies, awards).

Another key feature of Steam is its **digital rights management (DRM)**, which "is access-control technology used by manufacturers, publishers, and copyright holders to limit usage of digital devices or information" (EC-Council, 2010, pp. 9–26). In other words, DRM prevents unauthorized use or distribution of video games with a **payment gateway** used for collecting user fees and/or verifying user credentials before players can access all or parts of a game.

Along with Xbox Live and the PlayStation Network on home consoles, Steam has become an important contributor to the rise of independent video game development which began to take off in the late 2000s. Known as "**indie games**," independent video games are typically developed by individuals or small teams who

are free from the influence of big publisher budgets and time constraints. Many creative games have come from the indie scene, beginning with the NES-style 2D platformer *Cave Story* in 2004 by Japan's **Daisuke Amaya**. The game was "developed in his free time over the course of five years. Amaya wrote, developed, designed, composed, and everything else imaginable in this game himself" (Watlington, 2015, para. 5).

It would be several years before the indie gaming scene would really gain momentum with 2D platformers *Braid* (Figure 11.10a) by Jonathan Blow (2008) and *Spelunky* by Derek Yu (2009). The indie game movement continued into 2010 with *Limbo* by Danish developer Playdead and *Super Meat Boy* by American designers Edmund McMillen and Tommy Refenes. These and many other indie games homed in on the 2D platformer style of gaming that was both easier to program for and a style of game that most large publishers had long since abandoned in favor of 3D. The year 2011 was particularly big for indie games with *Terraria* by Re-Logic (Floyds Knobs, IN) and *Minecraft* (Figure 11.10b) by **Mojang** (Stockholm, Sweden) which emphasized exploration and construction. Successful indie role-playing titles that year included *Bastion* by Supergiant Games (San Jose, CA) and *To the Moon* by Canadian developer Freebird Games. The indie market would see more success in 2012 with games like *Fez, FTL: Faster than Light*, and *Journey*.

In addition to the indie scene, Steam has been a big supporter of mods, such as **Garry's Mod** (or **GMod**) in 2006. The sandbox physics game was created by **Garry Newman** as a mod for Valve's *Half-Life 2*, and like *Counterstrike*, was later made into a standalone release. There is even the "Steam Workshop," an account-based hosting service that encourages the development of user-created content or mods. Game mods are now a popular part of PC gaming culture and popular titles are seeing them often.

Another common PC trend that began in the mid-2000s was **episodic gaming**, where games are released in smaller segments over a period of time and players essentially pay for each new chapter of the game. This more modern take on the previous concept of expansion packs can be seen in **NCsoft**'s *Guild Wars* (2005) and Valve's own *Half-Life* series with *Half-Life 2: Episode One* (2006) and *Half-Life 2: Episode Two* (2007). Some companies such as **Telltale Games** (California) have built their entire development cycle around this structure. This can lead to extra publicity when each new chapter of a game is released, versus the single release of standalone title.

Lastly, Steam has become a huge **social network** for gamers. Each gamer has his or her own page (public or private) which lists the player's achievements, game wish lists, and other information. The platform includes community features such as friend lists and groups, as well as in-game voice and chat functionality where users can communicate freely. Gamers can identify when their friends are online and what games they are playing, in addition to inviting friends to their groups and joining other groups for multiplayer interactions.

DID YOU KNOW?

A Steam app was released for iOS and Android in 2012, and Windows Phone in 2016. The app allows users to manage games, browse the storefront, and chat with friends.

FIGURE 11.10 Screenshots from popular indie titles: (a) *Braid* (2009) and (b) *Minecraft* (2011).

(a)

(b)

■ VIRTUAL ONLINE WORLDS

Beyond Steam and MMORPGs, another type of game (if it can be called that) has become a common form of social interaction in the twenty-first century—**virtual online worlds**, sometimes referred to as **massively multiplayer online worlds (MMOWs)**. Dr. Carina Girvan (2013) has defined such a world as "a persistent, simulated and immersive environment, facilitated by networked computers, providing multiple users with **avatars** and communication tools with which to act and interact in-world and in real-time" (p. 4). An avatar is the user's virtual representation of him or her, also regarded as the user's "alter ego" or his or her "character."

The game that popularized the genre was "life simulation" game *The Sims* (2000) by **Will Wright**. According to John Seabrook from *The New Yorker* (2006), "while he was at home with his daughter, Wright began to turn over the idea for a new game, a kind of interactive doll house that adults would like as much as children" (pp. 15–16).

The avatars players create in *The Sims* are referred to as "sims" and the gameplay revolves around the sandbox-style game where players are free to roam about and interact with objects and characters. "Each sim also has six learnable skills (cooking, mechanical, charisma, body, logic, and creativity), which not only affect the way a sim interacts with his fellow sims but also how well he can make use of the objects in his house and how well he can perform his job" (Park, 2000, para. 4). *The Sims* went on to sell more than 16 million copies and holds numerous records, including "Best-Selling PC Game" in the *Guinness World Records: Gamer's Edition 2016* (Guinness World Records, 2015, p. 185). The series went massively multiplayer online with *The Sims Online* (Figure 11.11a) in 2002.

The following year a new virtual online world emerged from **Linden Lab** with *Second Life* in 2003. "*Second Life* pioneered the idea of a virtual world built by its users, and the freedom to build anything from a fully interactive Neverland to a functional virtual university" (PC Gamer, 2016, p. 4). The use of real currency exchange in virtual worlds like *Second Life* (called "Linden Dollars") has led many of its million or so users to a focus on using the platform to design and sell **virtual items**, from virtual clothing and accessories, to the construction and sales of virtual real estate.

Users like **Anshe Chung**, *Second Life* (Figure 11.11b) avatar of real-life **Ailin Graef** have made a living "**farming**" such virtual goods and selling them in the virtual community. Graef became the first virtual millionaire in 2006 from buying and developing virtual land and then renting or reselling the plots to other users (Parloff, 2005, para. 3). Chung is rumored to have earned $2 million over a period of just 30 months.

A similar success story can be found with the real-life, British actor/entreprenuer **Jon Jacobs** and his avatar **Neverdie** in the virtual *Project Entropia* (now *Entropia Universe*) (Figure 11.11c). Jacobs mortgaged his home in 2005 to buy a virtual asteroid for $100,000. He then constructed a virtual space resort called "Club Neverdie" which attracted players with "more than a dozen biodomes, a night club, stadium and a mall, where other players flocked to spend real cash on virtual goods and services" (Chiang, 2010). Jacobs sold Club Neverdie in 2010 for a total of $635,000.

Interacting in massively multiplayer online games and virtual worlds can be a great escape from reality for many people, as well as a safe environment to let go of

FIGURE 11.11 Screenshots of (a) *The Sims Online*, (b) *Second Life*, and (c) *Entropia Universe*.

(a) (b) (c)

TABLE 11.4 Memorable Virtual Worlds (Listed Alphabetically)

Title/Country/Launched	Title/Country/Launched
Active Worlds (USA, 1995)	PlayStation Home (England, 2008)
Blue Mars (USA, 2009)	Second Life (USA, 2003)
Entropia Universe (Sweden, 2003)	SmallWorlds (New Zealand, 2008)
Habbo (Finland, 2000)	There Inc. (USA, 2003)
IMVU (USA, 2004)	Twinity (Germany, 2008)
Onverse (USA, 2009)	Whyville (USA, 1999)

inhibitions and release a side of the personality that may otherwise be suppressed (see Table 11.4). These worlds may also be beneficial to the disabled or chronically ill, where they can create an avatar free of their disabilities or illnesses and temporarily engage in activities they may not be capable of in real life. Virtual worlds can also provide people with social disorders a more comfortable environment to socialize and form friendships. It is not uncommon to hear stories of cyber-dating and even virtual marriages that have occurred in these worlds—including people who have taken such relationships into the real world. Precautions should always be taken since avatars may not accurately portray their users.

DID YOU KNOW?

Researchers at Syracuse University studied 375 people playing *World of Warcraft* and found that 23% of male players chose female avatars, while 7% of female participants played as male characters (Duntley, 2014, p. 1).

■ RECENT TRENDS

The year 2009 saw an emergence of online **social games** that permit or require social interaction between players. Some of the most popular social games are actually "social network games" played through social networks such as **Facebook**. It was farming games like **Zynga**'s *Farmville* (2009) [influenced by *Happy Farm* in China (2008)] that helped the genre gain mainstream popularity (Kohler, 2009, para. 6). Other Zynga titles that helped lead the social gaming revolution included *Mafia Wars* (2008) and the top-ranking *Words with Friends* (2009). Social gaming would continue to grow over the next couple of years and many of these titles were ported to mobile gaming platforms.

The popularity of social gaming peeked in 2012 and then saw a steady decline as "revenue from social gaming apps fell 10 percent year over year" through 2015 (DiChristopher, 2015, para. 2). Zynga's stock price plummeted from $14.69 to less than $3 per share and Electronic Arts shut down its Facebook-based social games *SimCity Social, The Sims Social*, and *Pet Society* in June 2013. While fewer consumers were playing these games on social networks, social gaming remained popular on mobile devices. Social capabilities in games continue to be integrated in games today, where games like *World of Warcraft* and *GTA V* allow players to interact in a personal capacity.

Strategy, RPG, and casual games remained the dominant platforms on PC. Other genres that remained strong on PC included simulation, adventure, first-person shooters, and MOBAs. MOBAs such as Riot Games' *League of Legends* (2009), Valve's *DotA 2* (2013), Hi-Rez Studios' *Smite* (2014), and Blizzard Entertainment's *Heroes of the Storm* (2015) continue to be popular among gamers and eSports fans.

Viewing video games online has become a prevalent trend, not only through eSports, but also from modern technology that allows gamers to record or stream their gameplay live. **YouTube** remains the world's largest video streaming website, while Amazon subsidiary **Twitch** (twitch.tv) has become a phenomenon in the gaming world. Twitch is host to over 1.5 million broadcasters and a place for 100 million fans to watch and chat about their favorite video games every month (Needleman, 2015).

Watching video games has become so popular that according to the *Guinness World Records* (2015), "more than 27 million unique viewers tuned in to the Season 4

PRO FILE

WILL WRIGHT

KEY FACTS:

Popularized virtual life simulation games

Created the best-selling PC game for its time with The Sims in 2000

PRO FILE

HISTORY:

- Born: January 20, 1960, Atlanta, GA

EDUCATION:

- Louisiana State University (two years), Louisiana Tech University (two years) and The New School in Manhattan (one year)

CAREER HIGHLIGHTS:

- First game: Raid on Bungeling Bay (1984) for C64
- Formed Maxis with Jeff Braun in 1987 and made SimCity in 1989, SimEarth (1990), SimAnt (1991), and co-designed SimCity 2000 (1993) with Fred Haslam
- Designed the Sims (2000), The Sims Online (2002), The Sims 2 (2004), and Spore (2008)

RECOGNITION:

- Lifetime Achievement Award at the Game Developers Choice Awards in 2001
- Inducted into the Academy of Interactive Arts and Sciences' Hall of Fame in 2002

League of Legends World Championship finals [on October 19, 2014] with a peak audience figure of 11.2 million" (p. 29). Compare that to the 10.3 million viewers for the season finale of the hit TV show *Breaking Bad* in 2013.

Indie games are garnering more attention than ever before. *Minecraft* (2011) became the best-selling indie game of all time with 60 million copies sold before Swedish developer Mojang was acquired by Microsoft in 2014 (Guinness World Records, 2015, p. 103). The indie scene has continued to deliver consistent hit titles including *Guacamelee!* by DrinkBox Studios (Toronto) and *Gone Home* by Fullbright (Portland) in 2013; as well as *Monument Valley* by Ustwo Games (London) and *Shovel Knight* by Yacht Club Games (Valencia, CA) in 2014.

Subsequent years saw the indie scene grow even more prominent with games such as *Axiom Verge* by Thomas Happ Games (Las Vegas) and *Undertale* by Toby Fox (Boston) in 2015; *Owlboy* by D-Pad Studio (Norway) and *Hyper Light Drifter* by Heart Machine (Los Angeles) in 2016; as well as *Night in the Woods* by Infinite Fall (Manitboa/Pittsburgh) and *Pyre* by Supergiant Games (San Jose, CA) in 2017.

Another current trend includes **cloud gaming** by companies such as Crytek's **Gface**, Nvidia's **GeForce Now**, and **OnLive** (which was acquired by Sony Computer Entertainment in 2015). With cloud gaming (also called "gaming on demand"), the rendering of the game takes place on an external "cloud" server which streams game video or game files to the players. Cloud gaming provides a smoother multiplayer experience, while also helping counter video game piracy.

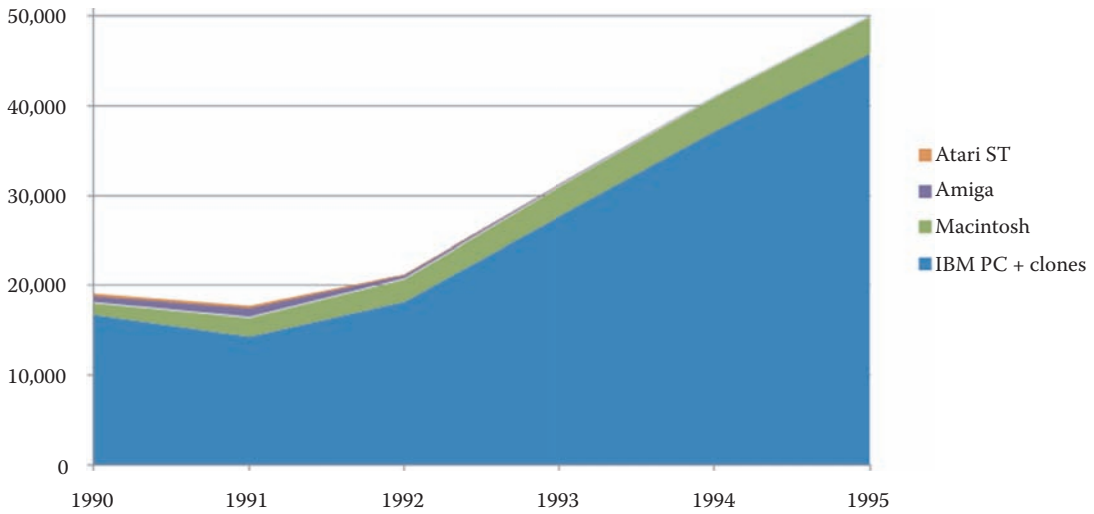
Virtual reality (VR) made its mainstream debut with a series of VR headsets released for Windows in 2016. **Oculus Rift** was released for PC on March 28, 2016 by **Oculus VR** (purchased by Facebook in 2014). The following week **HTC** and Valve Corporation released the **HTC Vive** VR headset on April 5, 2016. Oculus Rift launched at $599 and HTC Vive for $799, however, the price of a powerful PC must be added to that cost for a more accurate total of around $2,000. Sony released its own **PlayStation VR** for the PS4 for just $399 on October 13, 2016. For more information on PlayStation VR, see *Chapter 15: Modern Console Gaming*.

Then there are the mobile VR headsets like the **Samsung Gear VR** ($99), which is used in tandem with a compatible mobile device such as the Samsung Galaxy. Early VR titles have wowed those who have experienced their head-tracking immersion, however, most of these games have felt more like tech demos rather than fully realized video games. The potential is certainly there, but initial sales have been relatively slow.

■ MARKET SUMMARY

Reviewing the numbers behind the events in this chapter, PCs and clones "went from a 55[%] market share in 1986 to an 84% share in 1990. The Macintosh stabilized at about 6% market share and the Amiga and Atari ST at around 3% each" (Reimer, 2005, p. 6). By

FIGURE 11.12 Computer sales in thousands of units in the early 1990s (Reimer, 2012).



December of 1992, *Computer Gaming World* (1992) reported that MS-DOS software accounted for 82% of computer game sales, while Macintosh held an 8% share, leaving Amiga with 5% (p. 156) (Figure 11.12). Apple would reach an average 9% market share for a couple of years before dropping down to around 3% toward the end of the decade.

The end of the Atari ST was in sight when only 30,000 units were sold in 1993. This would be followed by the commercial failure of its Jaguar home console, leading to the 1996 merger of Atari and hard drive manufacturer **JTS** (named after co-founders **J**ugi Tandon and **T**om Mitchell from **S**eagate). Not long after the merger, the company ran out of money and the Atari intellectual property was sold to Hasbro in 1998. Finally, Hasbro was purchased by **Infogrames Entertainment (IESA)** in 2001, where Atari, Inc. has remained a wholly owned subsidiary.

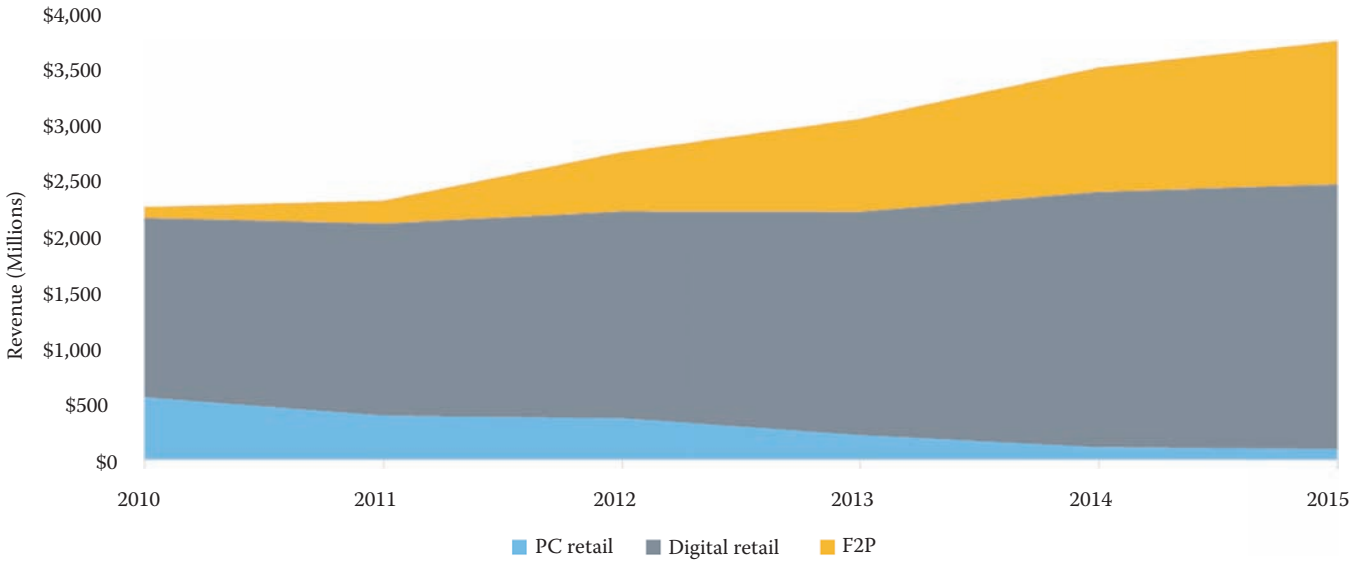
Even with its best-selling Amiga 500 and moderate success with the A1200, Commodore would not be able to keep up with the explosive sales of IBM and PC compatibles. Poor decisions such as its release of the inferior A600 further complicated matters. "Stuck with tons of old machines that couldn't sell and unable to build enough new machines for the Christmas '93 season, the company fell into a downward financial spiral which led inevitably to its bankruptcy in April 1994" (Reimer, 2005, p. 7).

PC compatible sales continued to rise while "Macintosh sales slumped. By 1998, PCs were closing in on sales rates of 100 million units per year, while Macintosh sales fell from 4.5 million in 1995 to just 2.7 million in 1998" (Reimer, 2005, p. 8). Windows 95 was a major contributor to the PC industry boom and Microsoft continued to release prominent successors such as Windows XP in 2001 and **Windows 7** in 2009.

Traditional, retail packaged software sales declined while digital and free-to-play revenues continued to grow. A key pioneer of this shift from PC retail to digital retail and F2P is Steam. Steam really took off between 2012 and 2015 (see Figure 11.13), with the quantity of Steam games released per year rising from just over 500 new games in 2013, to over 1500 titles in 2014, and nearly 3500 new titles in 2015. Concurrently, active Steam users rose from more than 60 million in October 2013 to over 150 million users by March 2016 (EEDAR, 2016, pp. 33–47). "What's more, the overall revenue for paid games on the platform [was] estimated at a staggering $3.5 billion for 2015" (Clayton, 2016, p. 1).

According to SuperData Research (2016), "interactive entertainment generated $91 billion in revenues in 2016" with $40.6 billion spent on mobile gaming (up 18%) and $35.8 billion on PC gaming (up 6.7%). Retail games generated $6.6 billion on digital downloads and another $2.7 billion on virtual reality. The video game industry is bigger than ever with more platforms than ever before. With so many options, the most difficult question for many gamers might be: "What game should I play next?"

FIGURE 11.13 PC market video game revenues in North America (EEDAR, 2016, p. 47).



■ ACTIVITY: LET'S NETWORK

There are many ways gamers and game fans can get together and share an online gaming experience. Let's get together in one of these capacities and experience it firsthand.

GUIDELINES

A computer will be necessary for each person in this activity. Discuss what platform (MMORPG, virtual world, Twitch, etc.) everyone would like to collaborate in and proceed to the appropriate website. Note that most of these platforms require a user account, so participants must be willing to create an account to proceed. When applicable, one user should create a group and share the name of that group for everyone else to locate and join. Spend 30 minutes or so engaged in the online collaboration, communicating only through the computer and not verbally in the room. Then take an additional 20–30 minutes to conduct a group SWOT analysis of the experience.

■ CHAPTER 11 QUIZ

1. The last two major gaming computers by Atari and Commodore included the:
   a. ST and Amiga
   b. ST and Macintosh
   c. Amiga and PCJr
   d. Amiga and PC-compatible

2. Became prominent for video applications like *Video Toaster* with its genlock ability:
   a. ST
   b. Amiga
   c. Macintosh
   d. PCJr

3. Who was *not* affiliated with Charles Ranlett Flint's consolidation to form IBM?
   a. Willard Bundy
   b. Alexander Dey
   c. Bill Gates
   d. Julius E. Pitrat

4. Many early PC games ran on _____ in which a command prompt would appear on the screen requiring the user to enter a series of commands to launch the program:
   a. DOS
   b. Linux
   c. OS X
   d. Windows

5. Developer of *Wolfenstein 3D* and *Doom* known for promoting networked multiplayer gaming, the concept of the "deathmatch," the shareware distribution method, and game modding:
   a. Ad Lib
   b. BioWare
   c. Creative Technology
   d. id Software

6. Became the mainstream operating system of both the general public and game developers in 1995:
   a. Linux
   b. OS/2
   c. OS X
   d. Windows 95

7. Which of the following is an application programming interface (API)?
   a. DirectX
   b. OpenGL
   c. Direct3D
   d. All of the above

8. Which game title was *not* one of the "big three" Massively Multiplayer Online Role-Playing Game (MMORPG) pioneers of the late 1990s?
   a. Asheron's Call
   b. EverQuest
   c. Ultima Online
   d. World of Warcraft

9. Which of the following titles is not considered a real-time strategy (RTS) game?
   a. Age of Empires
   b. Command & Conquer
   c. Guild Wars
   d. StarCraft

10. 3D accelerator cards like 3dfx Voodoo were eventually outmuscled by GPUs such as:
   a. Microsoft's Direct3D
   b. Nvidia's GeForce 256
   c. Silicon Graphics's OpenGL
   d. None of the above

11. In September 2003, a new digital distribution platform called Steam was released by:
   a. Apple
   b. Bethedsa
   c. Microsoft
   d. Valve

12. Games that are typically developed by individuals or small teams who are free from the influence of big publisher budgets and time constraints:
   a. Freemium
   b. Indie games
   c. MMORPGs
   d. None of the above

13. A virtual representation of a user, also called the user's "alter ego" or "character":
   a. Alias
   b. Avatar
   c. Bug
   d. Mod

14. Popularized virtual life simulation games with the best-selling game *The Sims* in 2000:
   a. Gary Newman
   b. Daisuke Amaya
   c. Jon Jacobs
   d. Will Wright

15. Researchers at Syracuse University studied 375 people playing *World of Warcraft* and found that ___ % of male players chose female avatars, while ___ % of female participants played as male characters:
   a. 23% of males and 7% of females
   b. 53% of males and 27% of females
   c. 17% of males and 23% of females
   d. None of the above

16. A _____ gamer could be defined as a person who is willing to build his or her schedule around gaming, whereas a _____ gamer simply fits in gaming when they have time:
   a. hardcore | casual
   b. casual | hardcore
   c. MOBA | MMOW
   d. MMOW | MOBA

17. Became wealthy by selling virtual real estate as alter egos Anshe Chung and Neverdie:
   a. Ailin Graef and Jon Jacobs
   b. Daisuke Amaya and Jon Jacobs
   c. Ailin Graef and Daisuke Amaya
   d. Minh Le and Jess Cliffe

True or False

18. PC-compatible systems were essentially IBM-style computers built by other companies and also referred to as "IBM clones."

19. The abbreviation MMORPG stands for "Mass Multimedia Role-Playing Game."

20. Purchasable downloads such as extra maps (stages), costumes, sports teams, and other bonus content are known as "macro-transactions."

■ FIGURES

Title page image: *Myst* (Cyan Worlds/Broderbund, 1995), *The Sims Online* (Maxis/EA Games, 2002), *World of Warcraft* (Blizzard Entertainment, 2004), and *League of Legends* (Riot Games, 2009).

FIGURE 11.1 Atari ST (a) and Commodore Amiga 500 (b) with peripherals. (Right: "Commodore Amiga 500, 16-bit computer (1987) Post Processing: BG, B/C, spot, composite picture." By Bill Bertram - own work, CC BY-SA 2.5. Available at https://commons.wikimedia.org/w/index.php?curid=350965. Retrieved from https://en.wikipedia.org/wiki/Amiga#/media/File:Amiga500_system.jpg. Left: "Atari 1040STf" CC BY-SA 2.5. Available at https://commons.wikimedia.org/w/index.php?curid=500910. Retrieved from https://en.wikipedia.org/wiki/Atari_ST#/media/File:Atari_1040STf.jpg)

FIGURE 11.2 Screenshots of popular computer titles: *Dungeon Master* (FTL Games, 1987 [a] on the Atari ST) and *The Secret of Monkey Island* (Lucasfilm Games, 1990 [b] on the Amiga 500) by Wardyga. (The Secret of Monkey Island courtesy of Lucasfilm Games, 1990; and Dungeon Master courtesy of FTL Games, 1987.)

FIGURE 11.3 Print advertisement for the Commodore Amiga 500 in 1987. ("Commodore Computers" posted by Bill and Renee Sanguinetti. Retrieved from http://www.magazine-advertisements.com/uploads/2/1/8/4/21844100/commodore-computers-2-1.jpg)

FIGURE 11.4 IBM PC 5150 magazine advertisement from 1982. (My Own IBM Computer Ad for the IBM PC 5150 from 1982. *Byte Magazine*, January 1982, p.61. UBM.)

FIGURE 11.5 A look at the MS-DOS prompt screen. Screenshot by Wardyga.

FIGURE 11.6 Screenshots from popular early 1990s PC titles: (a) *Myst* (Cyan Worlds/Broderbund, 1995) and (b) *The 7th Guest* (Trilobyte/Virgin Interactive, 1993) by Wardyga. (Myst courtesy of Cyan Worlds/Broderbund, 1995; and The 7th Guest courtesy of Trilobyte/Virgin Interactive, 1993.)

FIGURE 11.7 Two-page magazine advertisement for *Tomb Raider* in 1996. (From GamePro 88, November 1996, pp. 152–153.)

FIGURE 11.8 Screenshots from popular mid-1990s PC titles: (a) *Quake* (id Software, 1996) and (b) *Ultima Online* (Origin/Electronic Arts, 1997) by Wardyga. (*Quake* courtesy of id Software, 1996; and *Ultima Online* courtesy of Origin/Electronic Arts, 1997.)

FIGURE 11.9 Screenshots of late hit 1990s titles: (a) *Half-Life* (Valve Software/Sierra Entertainment, 1998) and (b) *EverQuest* (Sony Online Entertainment, 1999) by Wardyga. (*Half-Life* courtesy of Valve Software/Sierra Entertainment, 1998; and *EverQuest* courtesy of Sony Online Entertainment, 1999.)

FIGURE 11.10 Screenshots from popular indie titles: (a) *Braid* (Number None Inc., 2009) and (b) *Minecraft* (Mojang AB, 2011) by Wardyga. (*Braid* courtesy of Number None Inc., 2009; and *Minecraft* courtesy of Mojang AB, 2011.)

FIGURE 11.11 Screenshots of (a) *The Sims Online* (Maxis/EA Games, 2002), (b) *Second Life* (Linden Lab, 2003), and (c) *Entropia Universe* (MindArk, 2003) by Wardyga. (*The Sims Online* courtesy of Maxis/EA Games, 2002; *Second Life* courtesy of Linden Lab, 2003; and *Entropia Universe* courtesy of MindArk, 2003.)

FIGURE 11.12 Computer sales in thousands of units in the early 1990s. (Adapted from data by Reimer, Jeremy. "Personal Computer Market Share: 1975-2004" 2012. Retrieved from http://www.jeremyreimer.com/m-item.lsp?i=137)

FIGURE 11.13 PC Market Video Game Revenues in North America (EEDAR, 2016, p. 47). ("EEDAR - GDC2016 -Awesome Video Game Data Distribute" by Geoffrey Zatkin 2016. Retrieved from http://www.eedar.com/Pres/EEDAR%20-%20GDC2016%20-Awesome%20Video%20Game%20Data%20Distribute%20[Geoffrey%20Zatkin]%20v2.7.pdf)

Pro File: Will Wright. Photo credit: "Will Wright speaks at South by Southwest," March 13, 2007 by Nathan Borror. Retrieved from https://commons.wikimedia.org/wiki/File:Will_Wright_at_SXSW.jpg dia.org/w/index.php?curid=31557628.

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The Seventh Generation

OBJECTIVES

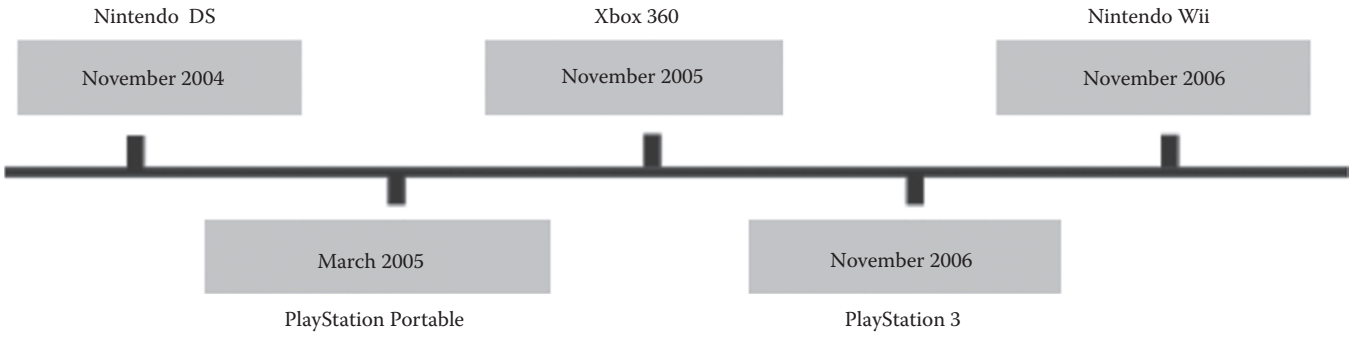
After reading this chapter, you should be able to:

- List several innovations introduced to gaming during this time period.
- Have a sense of graphics and other capabilities of seventh-generation games.
- Be familiar with the technological differences among seventh-generation consoles.
- Summarize a brief overview of what made each video game console unique.
- List some of the key video game titles and peripherals for each console.
- Recognize the importance the new technology had on the video game industry.
- Review the main video game contributions of Hideo Kojima.
- Be familiar with the handheld systems released during this time period.
- Summarize seventh-generation market sales.
- Explain why Nintendo dominated the seventh-generation market.
- Recognize the people who helped pave the way for these games and consoles.
- Describe the breakthroughs and trends in gaming during this era.

■ KEY TERMS AND PEOPLE

Accelerometer
Achievements
J Allard
Amazon Prime
Analog Devices
Apple
Kenichiro Ashida
ATI Technologies
BD-ROM
BioWare
Blades/NXE/Metro
Bluetooth
Blu-ray
Kevin Butler
Cell Processor
Mark Cerny
Classic Controller
CompactFlash
Component cable
Dashboard
Dolby Digital 7.1
Dual screen
DualShock 3
Gamer card
Teiyu Goto
GUI
Guide button
Gyroscope
HDMI
Hers Experimental Design Laboratory
Hulu
IBM
Insomniac
Kinect
Hideo Kojima
Ken Kutaragi
Jerry Lambert
Leap year bug
Life with PlayStation
Linux
LPCM
Memory Card Adaptor
Memory Stick
Memory Unit slot
Messenger Kit
Microtransactions
Mii
Shigeru Miyamoto
Motion controller
Multicore
Naughty Dog
Navigation controller
Netflix
Nintendo DS/Lite/DSi
NIS America
Nunchuk
Nvidia
Operation Rainfall
Optical audio output
Pack-in title
Pipelines
Pixel shaders
PlayStation 3
PlayStation Home
PlayStation Move
PlayStation Network
PlayStation Plus
PlayStation Store
Pro Controller
PSP
Red Ring of Death
Ring of light
Hironobu Sakaguchi
SD/Mini SD
Sensor Bar
Shader architecture
Sixaxis
Skins
Stylus
Tag
Toshiba
Touchscreen
Trophy system
Ubisoft
Universal Media Disc
Vertex shaders
Virtual Console
WebTV team
Wi-Fi
Wii
Wii Balance Board
Wii Menu
Wii MotionPlus
Wii Speak
Wii Wheel
Wii Zapper
Wiimote
Wireless Gaming Receiver
Wireless Keypad
Wireless Network Adapter
Xbox 360
Xbox Live
Xenon
Xenos
XrossMediaBar
Xseed Games
YouTube

■ CONSOLE TIMELINE



■ ARCADE UPDATE

NPD figures showed that the decline of the U.S. arcade industry in the late 1990s continued into the early to mid 2000s (Ivanovs, 2016, p. 12). The number of traditional arcade venues plummeted from 10,000 to fewer than 3,000 and "according to Vending Times' latest Census of the Industry, the number of arcade game units nationwide—at locations ranging from mini golf spots to movie theaters—sank from 860,000 in 1994 to 333,000 in 2004. Revenue from the games dropped from $2.3 billion to $866 million in that period" (East Valley Tribune, 2006, p. 1). Many considered the arcades dead.

By maintaining their focus on experiences unique from gaming at home and repositioning themselves as "family entertainment centers," North American arcades rebounded from a 2003 low of 2500 game venues to 3500 in 2008 (Hurley, 2008, para. 13). The resurgence of arcades in the United States was helped in part by their focus on food and drink service, party catering, and a variety of niche games and prizes. While still a far cry from the "Golden Age," arcades proved that they still had a place in America as a social activity for both younger and older gamers. By this time, most video arcade game hardware was based on the exact same technology as home consoles, such as the Dreamcast-compatible **NAOMI** and **Atomiswave**, the PlayStation 2-compatible **System 246**, and many others. Using the same technology greatly reduced development costs, making it easy for developers to port arcade games to home systems and vice versa.

Sega led the way with an accumulated 60 percent share of the arcade market in 2006 (Kikizo, 2006, p. 2). Rail shooters (Figure 12.1) and racing games remained most popular, followed by rhythm games like **Konami**'s Dance *Dance Revolution SuperNova* and later *Guitar Hero Arcade*. A handful of pinball tables, fighting games, and shoot 'em ups could still be found—along with retro cabinets like *Galaga* and *Ms. Pac-Man*—but these kinds of games were no longer prevalent in most U.S. arcades.

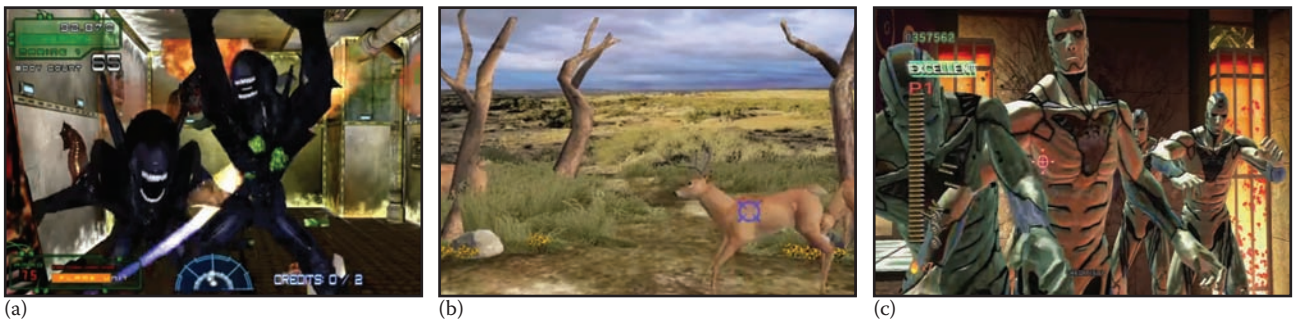
■ THE SEVENTH GENERATION

The seventh generation of video games began with the North American release of the handheld **Nintendo DS** on November 21, 2004, followed by the **PlayStation Portable (PSP)** the following month. It would be another year until Microsoft released the earliest seventh-generation home console, followed by offerings by Sony and Nintendo in late 2006. Home video games would see many breakthroughs and changes during this era, with influences from the mass adoption of HDTVs and smart phones, to larger internal storage, a rise in online, indie, and casual gaming, as well as new ways of playing games using motion technology. A number of these game changers came from Microsoft.

■ XBOX 360

The first console of the seventh generation was Microsoft's **Xbox 360** (Figure 12.2) which released on November 22, 2005 in the United States and the following month in Japan and Europe. The extravagant launch party involved a competition for tickets to "an undisclosed location in the Mojave desert," which turned out to be "a retired military hangar in Palmdale, Calif., that once housed the Space Shuttle. The massive set-up treated gamers to the first available consoles, as well as demo stations and cryptic viral marketing

FIGURE 12.1 Screenshots of top arcade rail shooters from 2006: (a) *Aliens: Extermination* (Global VR), (b) *Big Buck Hunter: Call of the Wild* (Raw Thrills), and (c) *House of the Dead 4* (Sega).



(a) (b) (c)

FIGURE 12.2 Xbox 360 with controller.

set-ups" (Huffman, 2013, para. 3). Two options were initially available, including the core system for $299 and the 20 GB hard drive version for $399. The system shipped 1.5 million units by year's end, selling out of 900,000 systems in North America and 500,000 consoles in Europe—although it struggled with just 100,000 units sold in Japan (Microsoft, 2006, p. 14). The original "Pro/Premium" package was bundled with one wireless controller, a component (HD-capable) AV cable, Ethernet cable, headset, and a removable 20 GB hard drive. Early versions also included a DVD remote control (Valdes, 2006, p. 2). See Table 12.1 for launch titles.

Where Microsoft sold the original Xbox at a loss, the 360 was designed to be more cost-effective and easier to program—although developers would have to learn how to program for a more complex **multicore** chip. The Xbox 360 was originally called "Project Xenon" after its main CPU by **IBM**. Microsoft's **WebTV team** worked closely with major chip vendor **ATI Technologies** on the development of its **Xenos** graphics chip.

Beyond its processors, the Xbox 360 advanced many features from the previous generation, such as improving its **Xbox Live** online gaming service. Xbox Live provided two membership options. The free "Xbox Live Silver" option allowed for the creation of a gamer **tag** (username) and a new ID type called a **gamer card**. "The gamer card is a profile that displays a gamer's interests, skill level, competitiveness and gaming accomplishments" (Valdes, 2006, p. 7). Silver plans also included system and game updates, chat functionality, and other downloadable content. For $59.99 per year, "Xbox Live Gold" added the ability to participate in multiplayer games online.

The original model required a separate **Wireless Network Adapter** to connect to the Internet via **Wi-Fi;** however, updates for Xbox Live "continuously transformed the service and gave a new look or functionality to the aging Xbox 360 hardware. It was a live service that changed with a simple update of its software. By 2007, Microsoft had more than 8 million subscribers to Xbox Live. By 2011, that number had climbed past 35 million" (Takashi, 2011, p. 3).

TABLE 12.1 Xbox 360 U.S. Launch Titles

- Amped 3
- Call of Duty 2 (Figure 12.3a)
- Condemned: Criminal Origins
- FIFA '06: Road to FIFA World Cup
- GUN
- Kameo: Elements of Power
- MaddenNFL 06
- NBA 2K6
- NBA Live 06
- Need for Speed: Most Wanted
- NHL 2K6
- Perfect DarkZero
- Peter Jackson's King Kong
- Project Gotham Racing 3 (Figure 12.3b)
- Quake 4
- Ridge Racer6
- Tiger Woods PGA Tour 2006
- Tony Hawk's American Wasteland

FIGURE 12.3 Xbox 360 launch titles (a) *Call of Duty 2* and (b) *Project Gotham Racing 3*.

(a) (b)

DID YOU KNOW?

According to **J Allard**, Microsoft Corporate Vice President and Chief XNA Architect, rather than naming it "Xbox 2," Microsoft chose "Xbox 360" to represent a focus on "putting the gamer at the center of the experience" (Torres & Thorsen, 2005, para. 21).

The Xbox 360 received a more comfortable, wireless standard controller that operated on either two AA batteries or a rechargeable battery pack. It also included backward compatibility with many original Xbox titles such as *Halo 2*. Its emphasis on digital media distribution and social networking helped promote the indie game revolution and console games became a lot more like PC games with updates as bugs were found and/or new game content released and in-game **microtransactions**. Furthermore, it was Microsoft and the Xbox 360 that introduced the world to the concept of **achievements**—digital rewards unlocked by completing various milestones in a game.

The 360 established a greater focus on the home console's **GUI (graphical user interface)**, which like the original Xbox was called the **Dashboard**. The Xbox 360 Dashboard could be quickly accessed by pressing the **Guide button** in the center of the controller. The Guide button was "divided into four quadrants that light up to provide gamers with different types of information during game play. For instance, during a split screen multiplayer match, a particular quadrant will light up to indicate to a player which part of the screen he or she is playing on at that time" (Valdes, 2006, p. 5). The console also featured a ring indicator around the power button called the "**ring of light**."

The original Xbox 360 design was created by **Astro Studios** in San Francisco and manufactured by **Hers Experimental Design Laboratory** in Japan. "While the original Xbox looked like it was about to explode, the Xbox 360 looked like it was inhaling" (Takashi, 2011, p. 4). Like the lights around the controller's Guide button, the ring of light around the console's power button had four glowing green lights that provided information such as which wireless controllers were active. Other messages the ring could display included the overheating code where the left half of the ring would flash red—and the dreaded "General Hardware Failure" error indicated by three flashing red quadrants around the power button. Known as the "**Red Ring of Death**," such hardware failures required users to ship their consoles to Microsoft for repairs.

The Red Ring of Death was a big problem and a 2009 reader poll by *Game Informer* showed a console failure rate of 54.2% from nearly 5,000 respondents (p. 11). Microsoft addressed the issue in an open letter from then Vice-President of Microsoft's Interactive Entertainment Business division **Peter Moore**. The letter was addressed to the Xbox Community and stated, "if a customer has an issue indicated by the three flashing red lights, Microsoft will repair the console free of charge—including shipping—for three years from the console's purchase date" (Moore, 2007). The decision to repair every console with the Red Ring of Death cost Microsoft an estimated 1.1 billion dollars (Crossley, 2016, p. 9). The problem was fixed for subsequent versions of the system, including the **Xbox 360 S** (Slim) released in 2010 and the **Xbox 360 E** in 2013. Table 12.2 summarizes the many different versions if the console.

TABLE 12.2 The Many Versions of the Xbox 360 (not including special editions)

Model	Debut	Internal Storage	Notes
Core	2005	None	Bundled with a standard-definition composite video cable and a wired controller
Original	2005	20 and 60 GB	Called "Pro" or "Premium," with a component cable, optional **optical audio output**, and hard drive; 2007 version had HDMI output
Arcade	2007	265 and 512 MB	Replaced core system with a small amount of internal memory and a wireless controller
Elite	2007	120 GB	Matte black finish and redesigned power connector with a 175 W power supply
Super Elite	2009	250 GB	More than double the hard drive space and bundled with two wireless controllers
S (Slim)	2010	4, 250, and 320 GB	Slim design, built in WiFi, no **Memory Unit slots**, 2 extra rear USB ports, proprietary port for Kinect sensor; new, quieter "Valhalla" motherboard; 50% less power consumption
E	2013	4, 250, and 500 GB	Xbox One-inspired design, one less USB port and no optical audio or S/PDIF connections

Along with new shapes and sizes of its console, Microsoft also reinvented the Xbox 360 Dashboard several times (Figure 12.4). The original Dashboard (known as "**Blades**") was the standard interface between 2005 and 2008. The second version was "**NXE (New Xbox Experience)**" in 2008, which could install full games onto the hard drive. The final Dashboard was the multimedia rich, Windows Phone-inspired "**Metro**" design in 2011.

Numerous accessories were released for the Xbox 360, including various headsets, remote controls, removable hard drives, force-feedback steering wheels, keyboard and mouse, rhythm game controllers, microphones, console **skins** (stickers), cooling systems, rechargeable batteries, and even a **Messenger Kit** featuring a miniature keyboard called the "Chatpad" that attached to the standard controller. Gamers could even play compatible

FIGURE 12.4 Evolution of Xbox 360 Dashboard: (a) Blades, (b) NXE, and (c) Metro.

(a) (b) (c)

Xbox 360 games on a Windows computer with the **Wireless Gaming Receiver** for Windows. Its **Live Vision Camera** was like Sony's EyeToy, allowing "players to create an in-game version of themselves in select games" (Valdes, 2006, p. 5).

Perhaps the console's best-known peripheral was the **Kinect**, shown in Figure 12.5. Formerly known as "Project Natal," the Kinect debuted on November 4, 2010 at Toys "R" Us in Times Square. The unique sensor device was built with the ability of detecting full-body 3D motion, facial recognition, as well as recognizing user voice commands. The "controller-free" experience offered by Kinect was much more advanced than the EyeToy and quickly earned the Guinness World Record for "fastest selling consumer electronics device" with 8 million units sold in its first 60 days on the market—an average of 133,333 units per day between November 4 and January 3 (Guinness World Records, 2010).

■ CONSOLE COMPARISON

At first glance, the casual consumer might assume that the Xbox 360's **3.2 GHz PC Tri-Core Xenon** CPU (Table 12.3) is a little more than 10 times faster than the 295 MHz "Emotion" CPU of the PS2. However, with a tri-core processor, each core functions as a separate processor, resulting in faster computing and more efficient energy consumption. And "because the Xbox 360 cores can each handle two threads at a time, the 360 CPU is the equivalent of having six conventional processors in one machine (Valdes, 2006, p. 3). Likewise, its **500 MHz** GPU may appear just over twice the speed of the original Xbox and GameCube GPUs, but its dedicated **10 MB of eDRAM** makes the Xbox 360 chip much faster than the raw numbers suggest.

ATI built the Xbox 360 GPU on unified **shader architecture**, utilizing **pixel shaders** that alter the lighting,

FIGURE 12.5 2010 Ingram Micro ad featuring Xbox 360S, Kinect and *Kinect Adventures!*

TABLE 12.3 Xbox 360 Tech Specs	
Manufacturer:	Microsoft
Launch Price:	$299.99 (Core) and $399.99
Release Date:	11/22/05 (US), 12/02/05 (EU), 12/10/05 (JP), 3/23/06 (AU)
Format:	12x speed DVD, CD, and HD DVD with add-on
Processors:	Power PC Tri-Core Xenon CPU (3.2 GHz) ATI Xenos GPU (500 MHz) with 10 MB of eDRAM
Performance:	Up to 1080p HD/500 million raw PPS/240 GFLOPS
Memory:	512 MB GDDR RAM (700 MHz)
Sound:	256-channel, 48 kHz 16-bit audio with Dolby 5.1 support

color, and surface of each pixel to help smoothen out 3D objects, giving them a more organic texture—as well as **vertex shaders** that manipulate an object's position in 3-D space, resulting in more realistic animation and special effects such as "morphing" (Valdes, 2006, p. 4). These computations must be processed through the **pipelines** of the chip. However, unlike last-generation consoles that required several pipelines for multiple effects, the ATI card in the Xbox 360 was designed to process both types of shaders over just one pipeline, making it much more efficient. Other advantages included more RAM, polygon count, and its many multimedia features.

HEAD-TO-HEAD

To compare the graphics and sound between the Xbox 360 and sixth-generation systems, check out each console's version of *Peter Jackson's King Kong, Tomb Raider: Legend, Hitman: Blood Money, Burnout: Revenge, Madden NFL 07*, and *NBA 2K7*.

■ KEY XBOX 360 TITLES

Close to 1200 games were released for the Xbox 360, not including downloadable titles. Because it beat the competition by a full year, many multiplatform games were released on the 360 first. Being the lead platform (particularly in the first few years) meant that the Xbox 360 versions of games were often superior. Such was the case with games like *Assassin's Creed, Bayonetta, Bioshock, F.E.A.R.*, and *Fallout 3*. It was the earliest console to receive **BioWare**'s *Mass Effect* and had a number of RPG exclusives including multiple *Fable* games, *Blue Dragon, Tales of Vesperia*, and *Lost Odyssey* (co-written by **Hironobu Sakaguchi** (creator of *Final Fantasy*). Some of the biggest titles were war games like *Call of Duty* and *Battlefield*, along with its best-selling *Halo* and *Gears of War* franchises shown in Figure 12.6.

FIGURE 12.6 Box art to five popular 360 titles including: (a) *Halo 3*, (b) *The Orange Box,* (c) *Mass Effect 3*, (d) *Grand Theft Auto IV*, and (e) *Gears of War 2*.

(a) (b) (c) (d) (e)

HANDHELD SNAPSHOT: PSP

The **PlayStation Portable** (PSP) (Figure 12.7) was released in the United States on March 24, 2005 for $249. It was the most powerful handheld for its time (see Table 12.4), featuring optical **UMD (Universal Media Disc)** format for both games and movies and an optional TV tuner.

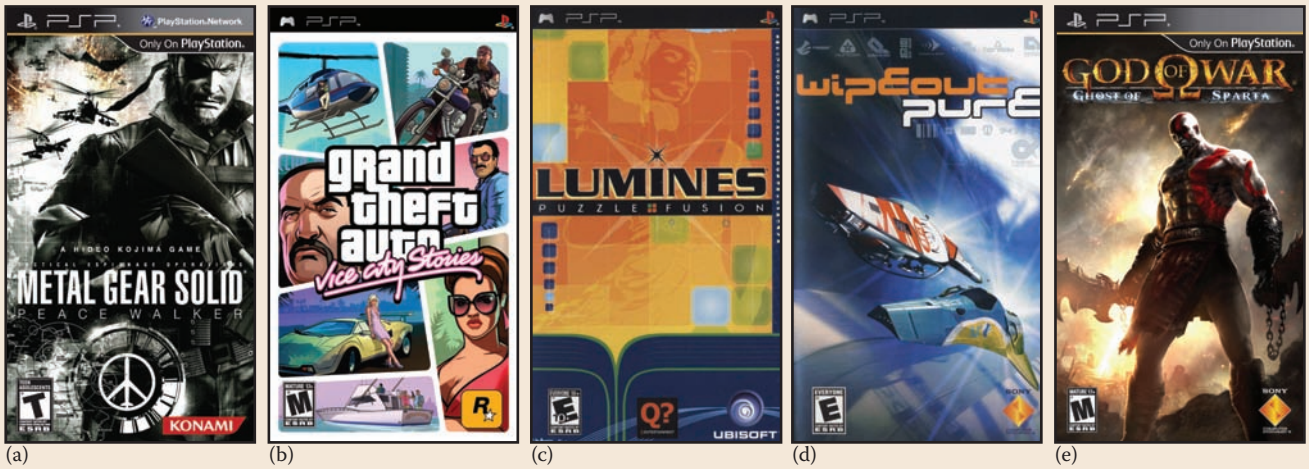
The different PSP models were known by their series code, that is, the original PSP was the PSP-1000, followed by the slimmer PSP-2000 in 2007 (called "Slim" and "Lite" in Europe), the mic-enabled PSP-3000 in 2008, and the PSP Go (2009) which replaced the UMD drive with 16 GB of internal flash memory. The PSP-2000 and 3000 models could output video and stereo audio to a television via **component cable**. More than 850 games were officially released for the PSP, with 80+ million systems sold. See Figure 12.8 for some of the best titles.

FIGURE 12.7 PlayStation Portable.

TABLE 12.4 PlayStation Portable Tech Specs

Format:	UMD/3.7 V lithium-ion battery (4.5 to 7 hours)
Processors:	32-bit Sony CPU (333 MHz)/166 MHz 512-bit GFX core
Performance:	16.77 million 16 or 24-bit colors/33 million PPS
Memory:	32 MB RAM + 4 MB combined eDRAM
Resolution:	480 × 272 pixels/4.3" diagonal backlit LCD screen
Sound:	Multichannel 3D sound, stereo speakers with 3.5 mm jack

FIGURE 12.8 Five defining PSP titles: (a) *Metal Gear Solid: Peace Walker*, (b) *Grand Theft Auto: Vice City Stories*, (c) *Lumines*, (d) *WipEout Pure*, and (e) *God of War: Ghost of Sparta*.



(a) (b) (c) (d) (e)

■ SONY PLAYSTATION 3

The **PlayStation 3** (PS3) (Figure 12.9) was the most powerful seventh-generation system. It was the first **Blu-ray** console and its multicore **Cell Processor** (by IBM, **Toshiba**, and Sony) was "essentially seven microprocessors on one chip, allowing it to perform several operations at once. In order to provide the sharpest graphics of any game system, Sony turned to **Nvidia** to build its graphics card" (Altizer, 2016, para. 8).

FIGURE 12.9 PlayStation 3 with DualShock 3.

The PS3 released in Japan on November 11 and in the United States on November 17, 2006. Europe and other areas would not see the console until March 23, 2007, due to "problems in mass producing elements of the high-definition Blu-ray disc drives in the machines" (BBC News, 2006, para. 3). Sony had initially planned to have 400,000 PS3 units ready for launch day, however research analyst Paul-Jon McNealy estimated that less than 200,000 were available for its North American debut (Baertlein, 2006, para. 3–4). Despite a successful, star-studded launch party (see Table 12.5 for launch titles), the shortage led to many empty-handed consumers and resellers making a hefty profit on eBay, with consoles selling for upward of $2,000.

The suggested retail price for the system was still a whopping $599 for a 60 GB hard drive, built-in Wi-Fi capability, and a flash card reader beneath a compartment next to the disc slot (for **CompactFlash** (**CF**), **SD/Mini SD**, and **Memory Stick** formats). A stripped-down 20 GB version was available for $499, but that model lacked all the aforementioned features. "Sony had essentially painted itself into a corner with the PS3's design. Between the system's highly touted Cell processor and its inclusion of a Blu-ray drive before that standard had established itself as the future ahead of HD-DVD … as high as the U.S. retail price of the PS3 was, Sony was still losing up to $300 on every system" (Sinclair, 2016, para. 5). Blu-ray ultimately won the battle over HD-DVD as the next generation optical disc and the PlayStation 3 was one of the most affordable Blu-ray players at the time of its release—similar to the PS2 as a DVD player 6 years earlier.

For its logo, PS3 console designer **Teiyu Goto** followed SCEI president **Ken Kutaragi**'s wishes of using the font from the then-current Spider-Man movies which Sony had the rights to (Ogden, 2007, p. 1). The original boomerang-shaped prototype controller was

TABLE 12.5 Sony PlayStation 3 U.S. Launch Titles

• Call of Duty 3	• NBA 2K7 (Figure 12.10a)
• Genji: Days of the Blade	• NHL 2K7
• Madden NFL 07	• Resistance: Fall of Man (Figure 12.10b)
• Marvel: Ultimate Alliance	• Ridge Racer 7
• Mobile Suit Gundam: CF	• Tiger Woods PGA Tour 07
• Need for Speed: Carbon	• Tony Hawk's Project 8
• NBA 07	• Untold Legends: Dark Kingdom

FIGURE 12.10 Screenshots from PS3 launch titles (a) *NBA 2K7* and (b) *Resistance: Fall of Man.*

(a)

(b)

replaced by a new **Sixaxis** controller than looked nearly identical to the PS2's DualShock 2 controller. The Sixaxis pad contained a built-in, rechargeable lithium-ion battery, as well as motion sensing ability along the X, Y, and Z axes for "six degrees of freedom." The original Sixaxis did not feature force feedback vibration until it was upgraded and replaced by the **DualShock 3** in 2008.

The PS3 contained numerous innovative features, such as remote connectivity with PlayStation Portable and **Bluetooth** 2.0 connectivity with other devices. Its Cell processor contained eight cores (six accessible to developers, one for the operating system and one for backup purposes). The CPU was so powerful that the U.S. military purchased a couple thousand PS3 consoles to cluster together to form a giant PS3-based supercomputer (Stokes, 2009, p. 1). The original console even included the ability to install operating systems such as **Linux**, although that feature would be removed with firmware update 3.21 in April 2010 due to security concerns. For game creation, the Core was such new and complex technology that developers struggled with the chip early on.

In addition to longer early development cycles, the new **PlayStation Network (PSN)** experienced a number of growing pains before it reached a comparable level with Xbox Live. PSN could be accessed through the PS3 GUI called the **XrossMediaBar** (XMB)—pronounced "Cross Media Bar"—along with other services such as *Photo, Music, Video, TV/Video Services*, and *Friends*. It wouldn't be until 2008 when Sony introduced its **trophy system**, PS3's answer to Xbox 360's achievements. "Trophy support became mandatory for all new games in January 2009" (Hutchings, 2013, para. 5). The year 2009 would be a pivotal one for the console, with the release of the smaller, lighter, and more efficient **PS3 Slim**, coupled with a brand new logo and complete redesign of its games' packaging (see Figure 12.11).

The PS3 didn't experience a failure rate epidemic like Xbox 360's Red Ring of Death; however, a 2009 study by warranty provider SquareTrade showed a 2-year failure rate for the original PlayStation 3 to be around 10%. Called the "yellow light of death" (YLOD) by the BBC's *Watchdog* program, Sony refuted the figure to be "less than half a percent of the 2.5 million consoles it has sold" (BBC News, 2009, para. 14).

Other challenges the system faced included a **leap year bug** on March 1, 2010, when numerous original PS3 systems experienced problems with their internal system clock, followed by a complete shutdown of the PlayStation Network due to a massive external **intrusion** (hack) on April 20, 2011. While the leap year bug was solved in about a day, the PSN **outage** lasted over three weeks. CBS News reported that the security breach affected more than 100 million online accounts and cost Sony roughly $171 million in damages (Martinez, 2011). The network was restored on May 15 with no sign of credit card fraud and Sony offered users a section of free digital perks as an apology.

Like the system's inclusion and then removal of features like Linux support and backward compatibility with PS2 games, the PSN saw a number of features come and go. **Folding@home** (March 2007–November 2012) was an initiative with Stanford University where PS3 users could share some of their console's computing power for disease research when the console was idle. **Life with PlayStation** (September 2008–November 2012) provided users with weather forecasts and other news headlines. Then there was ***PlayStation Home*** (December 2008–March 2015) which was a beta virtual

FIGURE 12.11 Old cover art and spine (a) and new style (b) for *LittleBigPlanet: GOTY ed.*

(a) (b)

TABLE 12.6 The Many Versions of the PS3 (not including special editions)

Model	Debut	Internal Storage	Notes
CECHAxx CECHBxx	2006	40 or 60 GB	Also called "Fat," had HDMI output, Six axis controller, 4 USB2.0 ports, PS2 backward compatibile, Linux support until update 3.21
CECHCxx CECHExx	2007	60 and 80 GB	60 GB was PAL only; 80 GB was NTSC only, Wi-Fi and flash card readers now standard; no Emotion chip = less backward compatible
CECHGxx through CECHQxx	2007–2008	40, 80, and 160 GB	Reduced to two USB 2.0 ports; no longer PS2 backward compatibile; added DualShock3 controller in 2008; more efficient Cell chip
CECH-20 through CECH-30	2009–2010	120 and 250, then 160 and 320 GB	Slim model; 33% smaller, 36% lighter and consumes 34–45% less power (Miller, 2009); cooler and quieter; remote control with HDMI
CECH-40 through CECH-43	2012	12, 250, and 500 GB	Super Slim model; approximately 25% smaller and 20% lighter than PS3 Slim; replaced motorized disc-loading slot with a manual sliding cover

3D social networking service similar to *Second Life*, where users created an avatar to communicate, shop, and engage in other virtual activities.

Advantages to PSN included free multiplayer gaming for all users and access to the **PlayStation Store** among other services. For an annual cost of $49.99, users could subscribe to **PlayStation Plus**—a premium PSN membership that provided users with early or exclusive access to betas, game demos, and even complete games with its "**Instant Game Collection**." On par with Xbox 360, the PS3 was also a popular platform for watching movies and TV shows with apps like **Netflix**, **Hulu**, and **Amazon Prime**. Also like the 360, the PlayStation 3 saw numerous different models over the years, with varying hard drive capacities and other changing features. Three years after the remodeled PS3 Slim, Sony released an even smaller PS3 system called the **Super Slim** in late 2012. Table 12.6 summarizes the many different versions if the system.

For better or for worse, the PlayStation 3 had some unforgettable television ads. The first series of ads took place in a white room, featuring all kinds of paranormal activity and ending with the caption "PLAY B3YOND." One ad featured a floating Rubik's Cube that explodes in the middle of the room, painting the walls blue, red, and green, and the floor yellow. Another showed a floating Sixaxis controller possessing a dozen eggs which roll toward it before flying backward and crashing into the wall—turning into a horde of crows. Perhaps the creepiest ad involved a deranged crying baby doll, whose tears suddenly retract before saying "ma ma" to a PS3 console on the floor (Figure 12.12a).

For the 2008 holidays, Sony released a series of "Entertainment Unleashed" spots "that focused on creating a portrait of the PSN's unrivaled ability to download movies to the PSP, and the PS3's ability to create unique experiences" (Oravasaari, 2012, para. 8). The next 3 years featured the fictional PlayStation rep **Kevin Butler** portrayed by actor **Jerry Lambert** (Figure 12.12b). The character had a different (humorous) subtitle for each commercial such as "Chief Weaponologist" and "VP of Fanboy Relations." Dozens of these commercials were produced, featuring the popular "It Only Does [fill in blank]" slogans.

Numerous accessories were released over the PS3's lifespan. Controller peripherals included charging stands, Blu-ray disc remotes, rhythm game peripherals like mics, guitars, and drum kits, as well as **Buzz**—a "buzzer" controller for game show titles featuring extra-large buttons in the same vein as Xbox 360's **Big Button Pad** controller. The **Wireless Keypad** featured a miniature keyboard that clipped onto the standard controller just like Xbox 360's Messenger Kit. Logitech produced several accessories such as the Driving Force GT steering wheel/pedal combo and the Cordless Precision. Other peripherals included headsets, a **Memory Card Adaptor** for previous generation game saves, an updated version of the EyeToy called **PlayStation Eye**, and the **PlayTV** digital video broadcasting (**DVB-T**) tuner peripheral with digital video recorder (DVR) functionality.

Sony saw further development in the motion game controller arena with the **PlayStation Move** in response to Microsoft's Kinect and Nintendo's seventh-generation controllers. The Move consisted of two different controllers: the **motion controller** was a wand that contained an orb at the end that glowed in various colors. It contained internal sensors in which the player's movements could be tracked by PlayStation Eye or **PlayStation Camera**. The handle featured a large

FIGURE 12.12 Screenshots from PS3 (a) "baby" commercial and (b) a "Kevin Butler" spot.

(a) (b)

"Move" button in the center, surrounded by the four action buttons, with the start and select buttons positioned on the sides. The underside of the controller housed one analog trigger, while the base of the unit contained a USB port, extension port, and a wrist strap. The second controller was the **navigation controller** which contained the left analog control stick, d-pad, and two trigger buttons (L1 and L2). Each controller contained the PS button on the topside.

■ CONSOLE COMPARISON: PS3 VERSUS XBOX 360

Both the Xbox 360 Xenon and PS3 Cell Processor run at 3.2 GHz (see Table 12.7); however, the Cell contained more than twice as many cores and a maximum of **230 Gflops** (Floating Point Operations Per Second)—versus 240 Gflops of the 360's CPU. Despite its core size advantage, "the Cell Processor, for all its sophistication, had its plusses and minuses. It was designed to support complex programming—and, at the same time, to resist hacking. Unfortunately, the complexity of the system made it so different from typical CPUs that developers became frustrated" (Altizer, 2016, para. 9).

Early cross-platform games on PS3 were commonly inferior to Xbox 360 versions, featuring lower framerates and/or resolutions, as well as longer load times. PS4 system architect **Mark Cerny** "admitted that PlayStation 3 had a 'weak lineup' of titles available at launch … describing Cell as a 'Rubik's cube' which made it difficult for developers to perform 'the most basic tasks'" (Scammell, 2013, para. 1–2). It took most developers years to master the Cell to finally get the most out of the chip, resulting in many of the best PS3 titles releasing during the latter half of the console's lifespan.

As for their GPUs, the Xbox **Xenos** shared its 512 MB with its system RAM, while the PS3 had **256 MB** of dedicated video RAM and could share another **224 MB** from the system RAM. "The Xbox had an advantage with its 10 MB of eDRAM, however, the PS3's **3.2 GHz** XDR RAM was much faster and more efficient than the Xbox 360's 700 MHz GDDR3 RAM, giving the PS3 the performance edge" (Schedeen, 2010). Originally both systems were backward compatible with last generation software (albeit far from perfect), however, Sony removed its Emotion Engine (PS2) chip in later models and discontinued backward compatibility altogether by 2008.

While each system supported full high definition and stereoscopic 3D games, being a Blu-ray drive allowed PS3 owners to also watch 3D Blu-ray movies on compatible displays. Compared to Xbox 360's dual layer (DVD-9) discs that had an 8.5 GB capacity, PS3's Blu-ray Disc ROM (**BD-ROM**) format could hold between 25 and **33.4 GB** of data. Games like *Final Fantasy XIII, L.A. Noire*, and *Rage* required three discs for the Xbox 360 but only one disc for the PS3. The Xbox 360 had stronger analog sound with Dolby Pro-Logic II support, while the PS3 was the clear choice for players with digital setups—offering DolbyDigital 5.1 (like Xbox 360), in addition to supporting **Dolby Digital 7.1** and **LPCM** (linear pulse code modulation) output.

TABLE 12.7 PlayStation 3 Tech Specs

Manufacturer:	Sony Computer Entertainment
Launch Price:	$499.99 & $599.99
Released Date:	11/11/06 (JP), 11/17/06 (US), 3/23/07 (EU)
Format:	2x Blu-Ray, 8x DVD, CD, and Super Audio CD
Processors:	Cell Broadband Engine CPU (3.2 GHz)
	Nvidia-based SCEI RSX "Reality Synthesizer" (550 MHz)
Performance:	Up to 1080p HD/275 million PPS/228.8 GFLOPS
Memory:	256 MB XDR DRAM (system) and 256 MB GDDR3 (video)
Sound:	320-channel, Dolby 5.1 & DTS Surround

Wi-Fi speeds were the same for both consoles, but the PS3 could connect to the Internet via Ethernet at **1 GB per second**, 10 times faster than the 360's 100 MBps Ethernet speed. Furthermore, the PS3 supported Bluetooth 2.0 for connecting to various devices. Comparing online networks, Xbox Live pioneered many features that Sony often replicated afterward. Microsoft led in this area most of the way, although the PSN was free and PlayStation Plus offered a lot of great exclusive content for paying members. By the end of the generation both platforms' online networks were fairly comparable. Likewise, neither the Kinect nor Move peripherals advanced the consoles as much as initially expected, with each platform being limited to mostly casual games.

HEAD-TO-HEAD

To compare gameplay and graphics between the PS3 and Xbox 360, check out games released on both systems. For games superior on PS3, compare *Darksiders, GTA V, L.A. Noire, Tomb Raider*, and *Vanquish*. For games superior on Xbox 360, compare *Bioshock, DmC: Devil May Cry, Ghostbusters, GTA IV*, and *The Elder Scrolls V: Skyrim*.

■ KEY PLAYSTATION 3 TITLES

Not counting its plethora of digital downloads, more than 1400 titles were released for the PS3 on disc. Early blockbuster titles included **Insomniac**'s *Resistance: Fall of Man* and *Ratchet & Clank Future: Tools of Destruction*. **Naughty Dog** pioneered a new hit franchise with *Uncharted: Drake's Fortune* and **Hideo Kojima** produced another PlayStation exclusive with *Metal Gear Solid 4: Guns of the Patriots*. A steady release of games followed with exclusive hits *LittleBigPlanet, Resistance 2, Valkyria Chronicles*, and *Uncharted 2: Among Thieves* (shown in Figure 12.13). Cross-platform hits included *Batman: Arkham Asylum/City* and sequels to *Assassin's Creed* and *Call of Duty: Modern Warfare*. Starting with *God of War: Collection* in 2009, each year the PS3 would see more "**HD Collection**" bundles of popular PS2 series on one Blue-Ray disc such as *The Sly Collection* in 2010.

DID YOU KNOW?

Up to this point, with each new generation, blockbuster titles have required more money and manpower to produce and develop. "One Electronic Arts executive estimated that it took 20 employees to make a PlayStation game, 80 to make a PS2 game, and 150 to make a PS3 game" (Takashi, 2011, p. 1).

Must-have titles really picked up after 2010 with *Heavy Rain* and *God of War III*, and by 2011 most cross-platform games were equal to or better than their Xbox 360 counterparts. Sony's last hurrah was in 2013 with a slew of PS3 exclusives including *Ni no Kuni: Wrath of the White Witch, The Last of Us, Beyond: Two Souls*, and *Dragon's Crown*.

FIGURE 12.13 Five defining PS3 titles including: (a) *Batman: Arkham City*, (b) *Uncharted 2: Among Thieves*, (c) *Grand Theft Auto V*, (d) *The Last of Us*, and (e) *BioShock Infinite*.

(a) (b) (c) (d) (e)

PRO FILE

KEY FACTS:

Pioneer of cinematic storytelling in video games

Often called "The Father of the Stealth Genre"

HIDEO KOJIMA

PRO FILE

HISTORY:

- Born: August 24, 1963, Setagaya, Tokyo, Japan

EDUCATION:

- Degree in Economics, Japan, 1986

CAREER HIGHLIGHTS:

- Writer, Director and Designer for Metal Gear (1987)
- Writer/Director for graphic adventure games Snatcher (1988) and Policenauts (1994)
- Planner, producer and director for Tokimeki Memorial Drama series (1997-1999)
- Writer, Producer, Director and Designer for all major entries in the Metal Gear Solid series (1998-2015)
- Producer/Designer for Zone of the Enders and Boktai series (2001-2006)

RECOGNITION:

- GDCA Lifetime Achievement Award in 2009
- Inducted into the Academy of Interactive Arts and Sciences' Hall of Fame in 2015
- The Game Awards 2016 Industry Icon Award

HANDHELD SNAPSHOT: NINTENDO DS

The **Nintendo DS** (Figure 12.14) was the first seventh-generation handheld, releasing before the PSP and first in the United States on November 21, 2004 for $149. See Table 12.8 for specs. While most gamers know the "DS" to stand for the system's **dual screen** display, Nintendo (2017) claims it also stands for "Developers' System" since "it gives game creators brand new tools which will lead to more innovative games for the world's players" (p. 1).

Among those tools is a lower **touchscreen** which can be used with fingers or a **stylus**. The original DS and the slimmer **DS Lite** are backward compatible with GBA games. The **DSi** models cannot play GBA games but add digital cameras and other features. Over 1800 games were published for the DS (see Figure 12.15 for top picks) and all but Chinese-version games are region free. Altogether more than 154 million DS systems have been sold, making it the best-selling handheld video game system of all time (Nintendo, 2016).

FIGURE 12.14 Nintendo DS.

TABLE 12.8 Nintendo DS Tech Specs

Format:	Mask ROM card/3.7 V lithium-ion battery (10 h)
Processors:	32-bit ARM946E-S CPU (67 MHz)/33 MHz co-processor
Performance:	262,144 colors/120,000 polygons per second
Memory:	4 MB (expandable via the Game Boy Advance slot)
Resolution:	256 × 192 pixels/dual backlit LCD screens (3" diagonal)
Sound:	16-channel, 8 and 16-bit PCM virtual surround/3.5 mm jack

FIGURE 12.15 Box art to DS hits (a) *New Super Mario Bros., (b) Castlevania: Dawn of Sorrow, (c) The Legend of Zelda: Phantom Hourglass, (d) GTA: Chinatown Wars*, and (e) *Mario Kart DS.*

(a) (b) (c)

(d) (e)

■ NINTENDO WII

Originally known as the "Revolution" for its promise to revolutionize video games, Nintendo's **Wii** (Figure 12.16) became the company's first home console to release in the United States before Japan, launching in New York's Times Square on November 19, 2006 for $249—less than half the cost of a PS3 at the time. The system reached other countries in the following weeks and would sell more than 1 million units during its launch, with more than 600,000 of those systems sold in the United States (Goldstein, 2006, para. 1).

In addition to being the most affordable new console on the market, its **Wii Remote** (also called "**Wiimote**") set it apart from the competition from the very beginning. Its simplistic design reduced the vast amount of action buttons that had become mainstream on other consoles, making it more accessible to non-gamers. Its resemblance to a remote control gave it a familiar appearance, but it also contained a built-in speaker and an **accelerometer** (by **Analog Devices**) that could sense motion (Takashi, 2011, p. 6). Arriving roughly four full years before Microsoft Kinect and PlayStation Move, the motion controls offered by the Wii were one of a kind for a home console and attracted gamers and non-gamers of all ages.

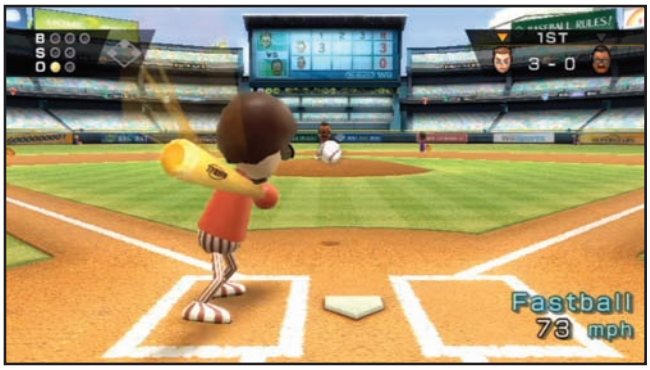
Nintendo took the complete opposite approach than the competition, using less advanced but more established technology that was much more affordable (rendering profits from day one). The system even featured full backward compatibility with all 8 cm **GameCube** games and included four GameCube controller ports and two memory card slots beneath its top panel. Like GameCube, Nintendo went with IBM for its main CPU and with ATI for its graphics processor—each of which were only a third faster than the chips in GameCube. Other than added Wi-Fi capability and the capacity for full-size 12 cm optical discs, the Wii's RAM and polygon performance were also not huge leaps forward from the

FIGURE 12.16 Nintendo Wii with Wiimote.

TABLE 12.9 Nintendo Wii Launch Titles

- Avatar: The Last Airbender
- Call of Duty 3
- Cars
- Dragon Ball Z: Budokai Tenkaichi 2
- Excite Truck
- Grim Adventures of Billy & Mandy
- GT Pro Series
- Happy Feet
- Legend of Zelda: Twilight Princess (Figure 12.17a)
- Madden NFL 07
- Marvel: Ultimate Alliance
- Monster 4×4: World Circuit
- Need for Speed: Carbon
- Rampage: Total Destruction
- Rayman
- Red Steel
- SpongeBob SquarePants: Creature from the Krusty Krab
- Super Monkey Ball: Banana Blitz
- Tony Hawk's Downhill Jam
- Trauma Center: Second Opinion
- Wii Sports (Figure 12.17b)

FIGURE 12.17 Screenshots of (a) *The Legend of Zelda: Twilight Princess* and (b) *Wii Sports*.



(a)

(b)

previous system. This led to arguments by some journalists and gamers that the Wii was just an upgraded GameCube with motion controls. Further rumors have indicated that motion controls were originally developed for the struggling GameCube.

Regardless of its processing power or history, the Wii's extensive launch lineup had something for everyone (Table 12.9). And just when the concept of a **pack-in title** with a launch edition console seemed like a concept of the past, Nintendo went against the grain even more by bundling *Wii Sports* with every console. The decision to bundle such an accessible "killer app" game with the Wii was a remarkable strategy by Nintendo and most certainly played a major role in the console's instant success.

The console was created by GameCube designer **Kenichiro Ashida** along with **Shigeru Miyamoto**. Its disc slot produced a stylish blue glow and its simplistic design complimented the easy-to-grasp controls, resembling the look of many **Apple** products at the time. Similar to how Sega removed their name from the forefront when marketing the **Dreamcast**, Nintendo's name and logo took a backseat in the marketing of the Wii. The console was simply referred to as "Wii," which was always written much larger and more pronounced than "Nintendo" in its marketing and packaging.

Its advertising featured players of all ages engaging in a shared Wii experience, as seen in Figures 12.18 and 12.19. Early advertising slogans included "Experience a new way to play" and "Wii would like to play."

Like avatars on Xbox 360, users could create a "**Mii**" character of themselves (as shown in Figure 12.18). As simplistic as the Mii characters looked, their style gave the console a unique personality of its own. Taking the concept one step further, each Mii could be used as a playable character in games such as *Wii Sports* and over 60 other titles.

The main graphical interface for the Wii was the **Wii Menu**, which included various "channels" such as the *Disc Channel* (which was where users opened disc-based Wii or GameCube games), the *Mii Channel* (for Mii creation), the *Photo Channel* (for loading picture slideshows from an SD card), as well as weather forecast and news channels. The *Wii Shop Channel* provided online access to other Wii channels, including *WiiWare* and ***Virtual Console*** where users could purchase downloadable versions of popular titles from previous Nintendo consoles, as well as games from the Sega Master System and Genesis, TurboGrafx-16, Neo•Geo, and many new, exclusive Wii titles. Like the other seventh-generation consoles, the Wii featured a web browser and downloadable channels such as **YouTube**, Netflix, Hulu Plus, and Amazon Video.

Along with the console, the original Wii package included *Wii Sports*, system manual, an external power adapter, composite AV cable, a plastic gray stand (for positioning the system vertically) with a clear round base, **Sensor Bar**, one Wii Remote with batteries, and one **Nunchuk** attachment used for controlling certain

FIGURE 12.18 Early Wii ad featuring *Wii Sports*.

games with an analog stick (featuring two action buttons labeled "C" and "Z").

DID YOU KNOW?

The term Wii is not an acronym or a previous word. According to Nintendo, "Wii sounds like 'we,' which emphasizes this console is for everyone. Wii can easily be remembered by people around the world, no matter what language they speak... Wii has a distinctive 'ii' spelling that symbolizes both the unique controllers and the image of people gathering to play" (Carless, 2006, para. 2). Also, it cannot be abbreviated.

Countless accessories were released for the Wii, with many borderline gimmicks such as hollow plastic golf clubs and rackets built to hold the Wiimote. While relatively inexpensive, these often did very little to enhance a person's performance in the games they were designed for—although the **Wii Wheel** and **Wii Zapper** made driving and shooting games more entertaining. For many of its retro and non-motion games, a **Classic Controller** was released, resembling the Super Nintendo controller with an additional two shoulder buttons and twin analog sticks. A **Pro** version was later released which featured more comfortable handles similar to the PlayStation controller.

FIGURE 12.19 Nintendo Wii ad for *Complex* (2006) featuring Tim Leong and Jared Ryder.

The **Wii MotionPlus** adapter used **gyroscope** technology to enhance the Wiimote's accuracy in games such as *Wii Sports Resort, Red Steel 2*, and *The Legend of Zelda: Skyward Sword.* The feature was later built into the **Wii Remote Plus**. Other accessories included a **Wii Speak** microphone, headsets, sensor bars, and popular rhythm game products (such as microphones, guitars, and drums). One of the most popular products was the **Wii Balance Board** for games like *Wii Fit* and *We Ski*. The Balance Board earned a Guinness World Record for the "Best-selling Personal Weighing Device" in November 2010 when it sold over 32 million units (Whitehead, 2012, para. 1).

Two variations of the Wii appeared late in the console's lifespan—neither of which were released in Japan and both of which were inferior to the original model. The first was the **Wii Family Edition** in 2011 which removed backward compatibility GameCube games and accessories. Its casing was identical to the original Wii, however, Nintendo haphazardly left empty holes under the top cover where the GameCube controller ports and memory card slots used to be. The **Wii Mini** released a little over a year later. It was Nintendo's first major redesign of a console since the Super Nintendo **SNS-101** in 1997, although beyond its stylish, smaller size the Mini also removed GameCube compatibility. Furthermore, this model omitted all networking abilities and was only capable of composite video output.

■ CONSOLE COMPARISON: WII VERSUS PLAYSTATION 3 AND XBOX 360

It was never Nintendo's intention to go head-to-head with Microsoft and Sony, and unlike those giants, the Wii was the only major seventh-generation console that did not feature high definition resolution or HDMI support. Nintendo firmly believed that an affordable system with unique, motion control gameplay would help it standalone in this console war. As Miyamoto explained, "power isn't everything for a console. Too many powerful consoles can't coexist. It's like having

TABLE 12.10 Nintendo Wii Tech Specs

Manufacturer:	Nintendo
Launch Price:	$249.99
Release Date:	11/19/06 (US), 12/02/06 (JP), 12/07/06 (AU), 12/08/06 (EU)
Format:	6× speed 8 cm and 12 cm Optical Discs
Processors:	IBM Power PC "Broadway" CPU (729 MHz) ATI "Hollywood" GPU (243 MHz)/12 GFLOPS
Res/Perform:	720 × 480p, 16:9/49.5 million PPS (up to 30 million with effects)
Memory:	88 MB (24 int. + 64 ext.), 3 MB texture
Sound:	64-channel, Dolby Pro Logic II

only ferocious dinosaurs. They might fight and hasten their own extinction" (Cios, 2015, para. 9).

Comparing the Wii to the technical specs of the PS3 or Xbox 360 finds the Wii inferior in practically every category (Table 12.10). Its network offerings were not as robust as Xbox Live or PlayStation Network, but it was a step in the right direction for Nintendo after the network-lacking GameCube. While Microsoft and Sony's machines contained internal hard drives up to hundreds of gigabytes in size, the Wii only contained 12 megabytes of internal flash memory and an SD card slot for external storage. It shared certain features such as wireless controllers, Wi-Fi connectivity, and the ability to stream Netflix—however, it lacked high definition resolution.

Besides HDMI, the Wii also lacked optical audio output and was "physically unable to output audio in Dolby Digital surround sound" (Casamassina, 2006, para. 1). While it could accept full-size 12 cm optical discs, it was not programmed for DVD movie playback. It did feature Bluetooth capability, including wireless connectivity with the Nintendo DS—something that was sorely lacking on Microsoft's system.

Like the Xbox 360 controller, the Wiimote required two AA batteries or a lithium-ion battery pack but lacked a built-in rechargeable battery like the PS3 controller. On the other hand, the Wiimote was the only seventh-generation controller to feature a built-in speaker, which made for some unique gameplay experiences. For example, when shooting an arrow in *The Legend of Zelda: Twilight Princess*, the sound of the released arrow travels from the Wiimote to the television speaker, creating a sense of depth. Moreover, for its first four years on the market, the Wii was the only console to feature such unique motion controls.

HEAD-TO-HEAD

There were a number of games that were released on all three seventh-generation consoles. Compare the gameplay and graphics to each system's version of *Call of Duty: Black Ops, Rock Band 2, Sonic & Sega All-Stars Racing,* and *Tomb Raider: Underworld.*

■ KEY WII TITLES

More than 1500 games were officially released for the Wii, not including download-only titles. More than 80% of these games reached U.S. retail shelves and, not unlike GameCube, the top 10 best-selling games on the Wii were all from Nintendo (Hill, 2012, para. 9). Many Mario titles were produced for the console, including the four-player *New Super Mario Bros. Wii, Super Paper Mario*, and two *Super Mario Galaxy* games. Other key titles published by Nintendo included two new *Zelda* and *Kirby* games, *Super Smash Bros. Brawl, Metroid Prime 3: Corruption* (and *Trilogy*), *Donkey Kong Country Returns, Punch-Out!!, WarioWare: Smooth Moves*, and *Mario Kart Wii.*

The system received decent third-party support from companies such as **Capcom** who published numerous exclusives such as *Zack & Wiki: Quest for Barbaros, Tatsunoko vs. Capcom: Ultimate All-Stars, Monster Hunter Tri*, and two *Resident Evil* rail shooters. Sega also published several exclusive hits for the system such as

FIGURE 12.20 Five Wii hits: (a) *Super Mario Galaxy*, (b) *Metroid Prime 3: Corruption*, (c) *Xenoblade Chronicles*, (d) *Super Smash Bros. Brawl*, and (e) *The Legend of Zelda: Twilight Princess.*

(a) (b) (c) (d) (e)

Super Monkey Ball: Banana Blitz, The House of the Dead: Overkill (later ported to PS3), *MadWorld*, and *Sonic Colors*. Notable releases published by **Ubisoft** included its *Red Steel, Rayman, Rabbids*, and *Just Dance* games, along with Grasshopper Manufacture's *No More Heroes 1* and *2*.

A few lesser-known titles that deserve mention include Treasure's *Sin and Punishment: Star Successor*, Vanilla Ware's *Muramasa: The Demon Blade*, WayForward's *A Boy and His Blob*, and Hudson Entertainment's *Marble Saga: Kororinpa*. In addition to third-party support from Activision Blizzard, Electronic Arts and Square Enix, the Wii was a popular platform for Japanese role-playing games during this generation. Numerous JRPGs were released by companies like **Xseed Games** and **NIS America**. Some of the most cherished titles were among the **Operation Rainfall** campaign which led to the Western localization of three titles including *Xenoblade Chronicles* (2011) (shown in Figure 12.20), *The Last Story* (2012), and *Pandora's Tower* (2013).

■ SEVENTH-GENERATION MARKET SUMMARY

Microsoft got off to an early lead by releasing the Xbox 360 a full year before Nintendo and Sony's new consoles. For the first few years, cross-platform games typically looked and/or ran better on Xbox 360 because developers were more familiar with the hardware, which was much easier to program for than the PS3. It was also the leading system for online gaming through much of the generation thanks to the company's commitment to Xbox Live. The console was less-expensive to produce than PS3 although not as lucrative as Nintendo's Wii, taking around a year before the units began to turn a profit.

While Microsoft was able to survive the Red Ring of Death epidemic with its first model systems, it struggled to make a dent in the Japanese market, selling even fewer units than the original Xbox with only 1.5 million sold after nearly 6 years on the market (Phillips, 2011, para. 1). In comparison, Microsoft Corporation (2008) reported that Xbox 360 had "sold over ten million units in the United States, making it the first [seventh] generation gaming console to break the ten million mark in the U.S., and contributing to global sales of over 19 million" (para. 1). In the end, the 360 sold more than three times as many units as the original Xbox, breaking 85 million units sold.

Sony had a rough start with the PS3, with its high price tag that lost the company approximately $300 per unit, along with some negative press to go with it. "Sony's Game division recorded a JPY 232.3 billion [$1.97 billion USD] loss, primarily due to selling the PS3 lower than the manufacturing price, as well as the associated costs of the worldwide launch" (Martin, 2007, para. 5). The following month, President of Sony Computer Entertainment Ken Kutaragi announced his plans to retire.

It took most developers a couple of years to gain a solid grasp on the Cell Processor and begin producing games that utilized more of the chip's potential.

During that learning curve, the console suffered from a number of subpar ports compared to Xbox 360 versions of the same games. Furthermore, games that used to be exclusives (or timed exclusives) on Sony consoles (such as *Final Fantasy*, *Grand Theft Auto*, and *Resident Evil*) began appearing on Microsoft's system simultaneously.

Falling manufacturing costs and the omission of the Emotion Engine helped Sony become profitable; however, the company continued to lose money on each console sold until around a year after the release of the PS3 Slim in 2010 (Reilly, 2010, para. 2). After dominating the previous two generations with the PlayStation and PlayStation 2, Sony found itself in unfamiliar territory. For the larger part of the console's lifespan, Sony was playing catch-up in North America where the "Xbox 360 outsold the PS3 in the U.S. for 32 consecutive months" (Metz, 2013, para. 1).

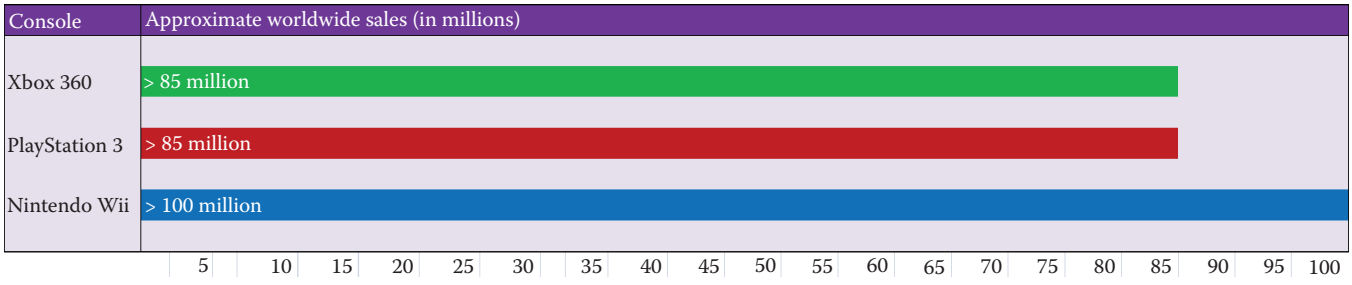
It took Sony 6 years to catch up to Microsoft, tying the number of units sold with Xbox 360 in November 2012 at approximately 70 million (Gera, 2012, p. 1). Like Microsoft's console, the PlayStation 3 would go on to sell over 85 million systems—an exceptional comeback, but still a far cry from the 155 million PS2 consoles it was able to move in the prior generation. The missteps of the PS3 taught Sony many lessons and it would be careful not to repeat those mistakes with its next console.

Nintendo struck gold with the Wii, generally outselling both Sony and Microsoft for numerous years after its release. After just 20 months on the market, the Wii surpassed the Xbox 360 in number of consoles sold with 10.9 million units sold (Keiser, 2008). It was the first time Nintendo led the home console market in overall units sold since the Super NES three generations prior. More than 57 million Wii systems had been sold by December 2010, which at the time was nearly equivalent to the total sales of Xbox 360 and PS3 consoles combined (VGChartz, 2010, p. 1).

On top of becoming the generation leader in consoles sold, Nintendo was also enjoying a greater profit margin since the Wii cost much less to manufacture. The company attained its goal of reaching a broader audience with the system, capturing the interest of gamers and non-gamers, young and old. It was not uncommon at that time to hear stories of the Wii being played in nursing homes and retirement communities, and other medical centers as a form of rehabilitation.

The Wii maintained the largest market share throughout the generation and by the end of 2011 Nintendo had sold 89.5 million Wii consoles for a 44% market share. The Wii would go on to sell more than 100 million units (Figure 12.21)—more than four times the number of GameCube consoles sold in the previous generation. On top of that, Nintendo's portable DS system went on to sell over 150 million units—the best-selling handheld system of all time and second overall only to the PS2 which holds the record for best-selling home video game console of all time.

FIGURE 12.21 Seventh-generation console sales graph.



■ SEVENTH-GENERATION BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the seventh generation of video games. Here is a list of the top 10 features that defined the generation:

1. Higher definition display resolutions via HDMI (up to 1080p, PS3/Xbox 360)
2. Blu ray capability (PS3) and HD-DVD add-on (Xbox 360)
3. More advanced online capabilities (microtransactions, games, movies, social)
4. Standard wireless controllers and rechargeable lithium-ion battery packs
5. Motion controls with Wiimote, PS3 Move, and Xbox Kinect
6. Console games became more like PC games with patches and updates
7. Rise of casual and indie, and episodic games
8. Powerful multicore processors and more RAM to work with
9. Higher efficiency GPUs and hundreds of millions of polygons per second
10. Multitude of console versions with various hard drive capacities, and so on

■ ACTIVITY: A VIRTUAL WORKOUT

In addition to entertainment-based games, a number of fitness titles were released during the seventh generation to take advantage of each console's motion control abilities.

GUIDELINES

Obtain a seventh-generation console with motion controls and other required accessories, along with one or two compatible fitness titles, some comfortable clothing and sneakers. Also obtain one or two regular fitness DVDs that do not contain any video game interactivity. Spend 10–15 minutes following the exercise routine from one of the regular fitness DVDs, followed by 10–15 minutes of a similar exercise routine from one of the fitness video game titles. Note that you may require additional time to enter personal information into the video game title before proceeding to the workout.

QUESTIONS

1. How do the experiences compare exercising to a regular DVD versus a fitness game?
2. What are the advantages and disadvantages to working out with each medium?
3. Do you think video game fitness titles will become more popular? Explain.

■ CHAPTER 12 QUIZ

1. This seventh-generation home console released approximately one year before the rest:
   a. PlayStation 3
   b. Xbox 360
   c. Wii
   d. None of the above

2. Introduced world to the concept of "achievements"—digital rewards unlocked by completing various milestones in a game:
   a. PlayStation 3
   b. Xbox 360
   c. Wii
   d. None of the above

3. Earned the Guinness World Record for "fastest selling consumer electronics device" with 8 million units sold in its first 60 days on the market:
   a. Microsoft Kinect
   b. Nintendo Wii
   c. PlayStation Move
   d. Wii Fit

4. One trait that sets the Sony PS3 apart from the Xbox 360 and Wii is its ability to play:
   a. Sega Dreamcast discs
   b. PSP discs
   c. Blu-ray discs
   d. All of the above

5. The Xbox 360's Dashboard, PlayStation 3's XrossMediaBar, and the Wii Menu are all examples of a:
   a. CPU
   b. GPU
   c. GUI
   d. HUD

6. Its Xenon CPU was built by IBM and its Xenos graphics chip made with ATI Technologies:
   a. PlayStation 3
   b. Xbox 360
   c. Wii
   d. None of the above

7. This system featured an optical UMD (Universal Media Disc) drive for both games and movies and an optional TV tuner:
   a. PlayStation 3
   b. Xbox 360
   c. Wii
   d. None of the above

8. A "General Hardware Failure" on Xbox 360 indicated by three flashing red quadrants around the power button:
   a. Ring of Light
   b. Red Ring of Death
   c. Overheating Warning
   d. None of the above

9. The initial cost to manufacture the PS3 was so high that Sony lost approximately _____ on each system sold:
   a. $100
   b. $200
   c. $300
   d. $400

10. Which motion control device allowed for a "controller-free" experience?
    a. Wiimote
    b. Sixaxis
    c. Move
    d. Kinect

11. This system's multicore Cell Processor was essentially seven microprocessors on one chip, allowing it to perform several operations at once:
    a. PlayStation 3
    b. Xbox 360
    c. Wii
    d. None of the above

12. Which of the following features was *not* a characteristic of the Nintendo Wii?
    a. Wiimote required two AA batteries or a lithium-ion battery pack
    b. Was the only seventh generation controller to feature a built-in speaker

c. Supported Dolby Digital 7.1 and LPCM (linear pulse code modulation) output
d. While it could accept full-size 12cm optical discs, it was not programmed for DVD movie playback

13. In shader architecture, _____ shaders alter the lighting, color, and surface of each pixel to help smoothen out 3D objects, while _____ shaders manipulate an object's position in 3-D space, resulting in more realistic animation and special effects such as morphing.
a. pixel (shaders) and vertex (shaders)
b. pixel (shaders) and axis (shaders)
c. spectra (shaders) and axis (shaders)
d. spectra (shaders) and vertex (shaders)

14. Each of these systems saw multiple models, including three different console designs:
a. PlayStation 3 and Wii
b. Wii and Xbox 360
c. Xbox 360 and PlayStation 3
d. All of the above

15. This network suffered a complete shutdown for three weeks due to a massive external intrusion (hack) on April 20, 2011, which affected more than 100 million online accounts and cost roughly $171 million in damages:
a. Virtual Console
b. PlayStation Network
c. WiiWare
d. Xbox Live

16. Which game console dominated the seventh-generation in terms of overall units sold?
a. Sega Dreamcast
b. Microsoft Xbox 360
c. Sony PlayStation 3
d. Nintendo Wii

True or False

17. North American arcades rebounded from a 2003 low of 2500 game venues to an increase of 3500 in 2008.

18. The original Xbox 360 model required a separate Wireless Network Adapter to connect to the Internet via Ethernet.

19. The Nintendo Wii launched at a lower price than both the Xbox 360 and PS3.

20. In almost every generation of video game consoles, the most powerful console had the highest sales figures and won the console war for that time period.

■ FIGURES

FIGURE 12.1 Screenshots of top arcade rail shooters from 2006: (a) *Aliens: Extermination* (Global VR), (b) *Big Buck Hunter: Call of the Wild* (Raw Thrills), and (c) *House of the Dead 4* (Sega). (*Aliens: Extermination* courtesy of Play Mechanix/Global VR, 2006; *Big Buck Hunter: Call of the Wild* courtesy of Incredible Technologies/Raw Thrills, 2006; and *House of the Dead 4* courtesy of Sega, 2006.)

FIGURE 12.2 Xbox 360 with controller. "The Xbox 360, a video game console released by Microsoft in 2005. This is the "Pro" model from the launch line-up, which featured a 20GB hard drive, wireless controller and a silver DVD bezel." By Evan Amos. Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=33220305. Retrieved from https://en.wikipedia.org/wiki/Xbox_360#/media/File:Xbox-360-Pro-wController.jpg.

FIGURE 12.3 Xbox 360 launch titles (a) *Call of Duty 2* and (b) *Project Gotham Racing 3*. (*Call of Duty 2* courtesy of Infinity Ward/Activision, 2005; and *Project Gotham Racing 3* courtesy of Bizarre Creations/Microsoft Game Studios, 2005.)

FIGURE 12.4 Evolution of Xbox 360 Dashboard: (a) Blades, (b) NXE, and (c) Metro. ("The new Xbox dashboard arrives tomorrow – Let's look at how it's evolved" by Joey Davidson, November 11, 2015. Retrieved from https://www.technobuffalo.com/2015/11/11/xbox-dashboard-history/)

FIGURE 12.5 2010 Ingram Micro ad featuring Xbox 360S, Kinect and *Kinect Adventures! ("Xbox Kinect Adventures,"* Posted March 22, 2011. Available at http://rwee406rib.blogspot.com/2011/05/xbox-kinect-adventures.html).

FIGURE 12.6 Box art to five popular 360 titles including: (a) *Halo 3*, (b) *The Orange Box*, (c) *Mass Effect 3*, (d) *Grand Theft Auto IV*, and (e) *Gears of War 2*. (*Halo 3* courtesy of Bungie/Microsoft Game Studios, 2007; *The Orange Box* courtesy of Valve Software/EA Games, 2007; *Mass Effect 3* courtesy of BioWare/Electronic Arts, 2012; *Grand Theft Auto IV* courtesy of Rockstar North/Rockstar Games, 2008; and *Gears of War 2* courtesy of Epic Games/Microsoft Game Studios, 2008.)

FIGURE 12.7 PlayStation Portable. ("Original Model PSP (PSP-1000)" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11337256. Retrieved from https://en.wikipedia.org/wiki/PlayStation_Portable#/media/File:Psp-1000.jpg

FIGURE 12.8 Five defining PSP titles: (a) *Metal Gear Solid: Peace Walker*, (b) *Grand Theft Auto: Vice City Stories*, (c) *Lumines*, (d) *WipEout Pure*, and (e) *God of War: Ghost of Sparta*. (*Metal Gear Solid: Peace Walker* courtesy of Kojima Productions/Konami, 2010; *Grand Theft Auto: Vice City Stories* courtesy of Rockstar Leeds/Rockstar Games, 2006; *Lumines* courtesy of Q Entertainment/Ubisoft, 2005; *Wipeout Pure* courtesy of Studio Liverpool/SCEA, 2005; and *God of War: Ghost of Sparta* courtesy of Ready at Dawn/SCEA, 2010.)

FIGURE 12.9 PlayStation 3 with DualShock 3. ("Original PlayStation 3 model" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11346934. Retrieved from https://en.wikipedia.org/wiki/2011_PlayStation_Network_outage#/media/File:Ps3-fat-console.png).

FIGURE 12.10 Screenshots from PS3 launch titles (a) *NBA 2K7* and (b) *Resistance: Fall of Man*. (*NBA 2K7* courtesy of Visual Concepts and Kush Games/2K Sports, 2006; and *Resistance: Fall of Man* courtesy of Insomniac Games/SCEA, 2006.)

FIGURE 12.11 Old cover art and spine (a) and new style (b) for *LittleBigPlanet: GOTY ed.* (Courtesy of Media Molecule/SCEA, 2009.)

FIGURE 12.12 Screenshots from PS3 (a) "baby" commercial and (b) a "Kevin Butler" spot. (Courtesy of TBWA\Chiat\Day Los Angeles.)

FIGURE 12.13 Five defining PS3 titles including: (a) *Batman: Arkham City*, (b) *Uncharted 2: Among Thieves*, (c) *Grand Theft Auto V*, (d) *The Last of Us*, and (e) *BioShock Infinite*. (*Batman: Arkham City* courtesy of Rocksteady Studios/Warner Bros. Interactive Entertainment, 2011; *Uncharted 2: Among Thieves* courtesy of Naughty Dog/SCEA, 2009; *Grand Theft Auto V* courtesy of Rockstar North/Rockstar Games, 2013; *The Last of Us*courtesy of Naughty Dog/SCEA, 2013; and *BioShock Infinite* courtesy of Irrational Games/2K Games, 2013.)

FIGURE 12.14 Nintendo DS. ("An original Nintendo DS "Fat" in blue" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14501145. Retrieved from https://en.wikipedia.org/wiki/Nintendo_DS#/media/File:Nintendo-DS-Fat-Blue.png)

FIGURE 12.15 Box art to DS hits (a) *New Super Mario Bros.*, (b) *Castlevania: Dawn of Sorrow*, (c) *The Legend of Zelda: Phantom Hourglass*, (d) *GTA: Chinatown Wars*, and (e) *Mario Kart DS*. (*New Super Mario Bros*. courtesy of Nintendo, 2006; *Castlevania: Dawn of Sorrow* courtesy of Konami, 2005; *The Legend of Zelda: Phantom Hourglass* courtesy of Nintendo, 2007; *GTA: Chinatown Wars* courtesy of Rockstar Leeds/Rockstar Games, 2009; and *Mario Kart DS* courtesy of Nintendo 2005.)

FIGURE 12.16 Nintendo Wii with Wiimote. ("Wii with Wii Remote" by Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=11477211. Retrieved from https://en.wikipedia.org/wiki/Wii#/media/File:Wii-Console.png Wrist strap graphics modified by Wardyga.)

FIGURE 12.17 Screenshots of (a) *The Legend of Zelda: Twilight Princess* and (b) *Wii Sports*. (Courtesy of Nintendo, 2006.)

FIGURE 12.18 Early Wii ad featuring *Wii Sports*. (From Stars and Avatars: Final Project by Samantha Seath, December 13, 2012. Retrieved from https://samanthaseath.wordpress.com/2012/12/13/wii-advertisement/)

FIGURE 12.19 Nintendo Wii ad for *Complex* (2006) featuring Tim Leong and Jared Ryder. ("Nintendo Wii Gives Back To Africa" Photo by Jared Ryder, September 3, 2009. Retrieved from https://djtreats.com/2009/09/03/nintendo-wii-gives-back-to-africa/)

FIGURE 12.20 Five Wii hits: (a) *Super Mario Galaxy*, (b) *Metroid Prime 3: Corruption*, (c) *Xenoblade Chronicles*, (d) *Super Smash Bros. Brawl*, and (e) *The Legend of Zelda: Twilight Princess*. (*Super Mario Galaxy* courtesy of Nintendo, 2007; *Metroid Prime 3: Corruption* courtesy of Retro Studios/Nintendo, 2007; *Xenoblade Chronicles* courtesy of Monolith Soft/Nintendo, 2012; *Super Smash Bros. Brawl* courtesy of Game Arts/Nintendo, 2008; and *The Legend of Zelda: Twilight Princess* courtesy of Nintendo, 2006.)

FIGURE 12.21 Seventh-generation console sales graph. (Designed by Wardyga using data from VGChartz. (2017). Global Hardware Totals. Retrieved from http://www.vgchartz.com/)

Pro File: Hideo Kojima. Hideo Kojima at E3 2006 with Gameplay (magazine) award for Best story of the year 2005. Posted June 28, 2007. By Sergey Galyonkin from Kyiv, Ukraine - Hideo Kojima Uploaded by Yakiv Gluck, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=27482064. Retrieved from https://commons.wikimedia.org/wiki/File:Hideo_Kojima_at_E3_2006.jpg

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Military, Science, and Education Climb Aboard

OBJECTIVES

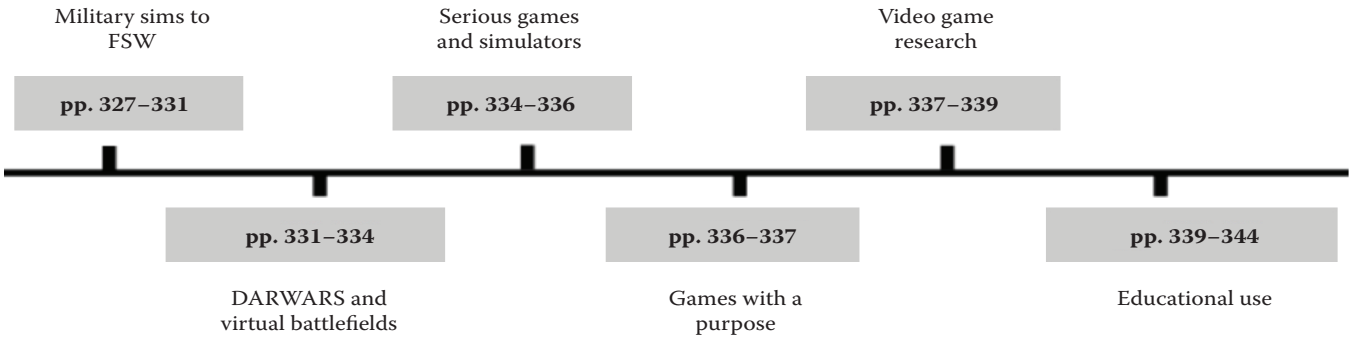
After reading this chapter, you should be able to:

- Describe some classic military-themed board games used for war preparation.
- Explain the difference between field exercises and virtual-based simulations.
- List several Tactical Engagement Simulations used by police and the military.
- Summarize military training simulators and what makes each program unique.
- Elaborate on the DARWARS project, including *DARWARS Ambush!* and *TLCTS*.
- Describe the features of the *Virtual Battlespace* series and how it progressed.
- Illustrate how simulation software can help with PTSD and other disorders.
- Review serious games and GWAPs used by scientists and medical professionals.
- List some commercially available medical simulation titles.
- Be familiar with the Serious Games Showcase and Challenge and recent winners.
- Discuss the significance of "games with a purpose" and how they help scientists.
- Reflect on the potential positive and negative effects of video games on people.
- Explain how video games are being used in education today.
- Provide examples of educational game titles and educational video game websites.
- Be familiar with Quest schools and The Princeton Review's top schools list.

■ KEY TERMS AND PEOPLE

Advanced Squad Leader
After Action Review
Alelo Inc.
America's Army
Mark Appelbaum
Atomic Games
Avalon Hill
Avatar
Scott Barnett
Battlezone
Daphne Bavelier
Vikranth Bejjanki
BBN Technologies
Bohemia Interactive
Brad Bushman
CICS ChicagoQuest
Citizen science
Clinical Skills and Simulations Centers
Close Combat
Crowd-sourced science
DARPA
DARWARS/Ambush!
Desensitization
Disney Interactive
Disney Junior
Marine Doom
Edutainment
Electrographic sensor
EST
Epic Games
ESP Game
EteRNA
Exposure therapy
F.A.T.S
Field exercises
First-person shooter
Flight simulator
Foldit
Full Spectrum Warrior
Alessandro Gabbiadini
Game After Ambush
Game with a purpose
Game-based learning
Gamification
Adam Gazzaley
GCompris
Berni Good
Google Image Labeler
Hexgrids
High-fidelity patient simulations
Human dimension modeling
I/ITSEC
Information Systems for Medicine
Institute of Play
iPad
Kahoot!
Knowledge Adventure
Königsspiel
Kriegsspiel
Charles C. Krulak
Simone Kühn
David Lagettie
LeapFrog Enterprises
LeapPad
Leapster
Learning Company
Life simulation
M2 Bradley
Military exercises
Minecraft
Motion Reality Inc.
Multipurpose Arcade Combat Simulator
NeuroRacer
Nick Jr.
Nintendo DS
NTSA
Maressa Hecht Orzack
Outerra
Pandemic Studios
PBS Kids
Princeton Review
PTSD
Quest to Learn
RAND Corporation
Raytheon Company
Real Virtuality 2
Real-time tactics
Charles Roberts
Chen Rong-Yu
James Rosser Jr.
SAFE
Savage Entertainment
Sculptured Software
Second Life
SECTER
Self Determination Theory
Serious games
SG Showcase and Challenge
David Sheff
SIMNET
Simulation
Smart Board
Dan Snyder
Society for Simulation in Healthcare
Software Toolworks
William Henry Stahl
Steam
Stroop Effect test
Tactical Iraqi
Team Orlando
TES
THQ
TitanIM
TLCTS
Total Immersion Software
TRADOC
Bradley Trainer
Unreal Engine
VBS1, 2, 3, & Blue
Video game addiction
VIRTSIM
Virtual battlefield
Virtual Battlespace
Virtual reality/therapy
Virtual worlds
Luis von Ahn
Georg Leopold von Reiswitz
War games
Casey Wardynski
Christopher Weikmann

■ CHAPTER OUTLINE



■ INTRODUCTION

As technology has matured, interactive media has received more and more attention and usage by the U.S. military, scientists, and educators. Computer programs are now being utilized in capacities from training simulators for combat and rescue operations, to studies on motor skill development, stress relief, and social development. Educators are now exploring virtual learning as a safe place for students to develop perceptual, attentional, and cognitive abilities—and the number of colleges and universities offering degrees in and related to game development continues to grow. This chapter will review how the technology has been used by military, scientific, and educational communities.

■ EARLY WAR GAMES

The U.S. military has a long history of using games as a part of combat training. Even "before video games, troops were encouraged to play military-themed board games" (Romaniuk and Burgers, 2017, para. 3). One of the earliest games used for war preparation was ***Königsspiel***, or "the King's Game" developed in 1664 by Germany's **Christopher Weikmann**. This extension of the classic game of *Chess* was a breakthrough in that it provided a visualization of the player's movements and actions on a game board where the behavior of forces could be better analyzed.

More than a century would pass until the next significant, German-developed war game ***Kriegsspiel*** was produced in 1811 by Baron **Georg Leopold von Reiswitz**. *Kriegsspiels* was "a more detailed board game using contoured terrain and porcelain soldiers, which introduced the concept of a starting scenario with a stated military objective" (McLeroy, 2008, para. 5). War games of the 1950s added hexagonal overlays (**hexgrids**) for tracking movement and engagement, later used in strategy video games such as *Nobunaga's Ambition* (1983) and *Military Madness* (1989), among others.

Major developments came from **Avalon Hill** by entrepreneur **Charles Roberts** and Douglas Aircraft Company's **RAND Corporation** (Research and Development). Soon theater-level warfare games like ***SAFE (Strategy and Force Evaluation)*** introduced combat-results tables and the use of dice to randomize the events and outcomes of each battle, allowing for "more mathematically accurate actions than those found on sand tables and board games of earlier centuries" (McLeroy, 2008, para. 7). In addition to planning and training tools for the military, war games eventually became popular forms of entertainment for the general public. When video games

FIGURE 13.1 The simulation spectrum.

FIGURE 13.2 Firearms training simulator (a) and engagement skills trainer (b).

(a)

(b)

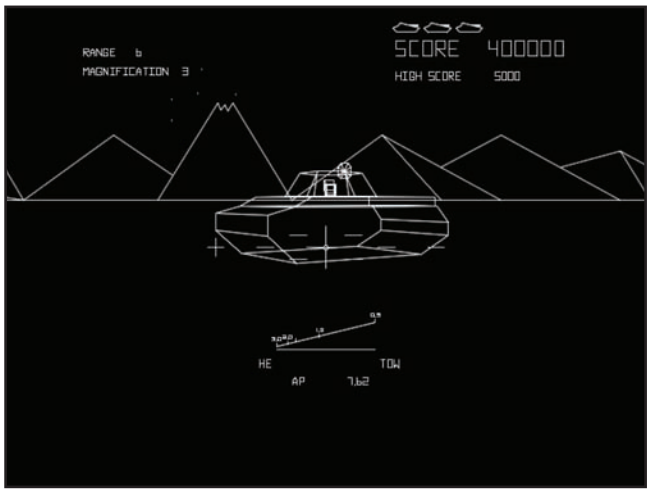
became the next big thing in the late 1970s, the popularity of electronic **war games** and **simulations** followed.

■ MILITARY SIMULATION

War games used by the military are commonly referred to as **military exercises**. These exercises provide insightful training for military operations, such as testing various strategies without actual combat and the assessment of warfare effects. These simulations can range from the full-scale rehearsal of military maneuvers known as **field exercises**, to more virtual-based simulations such as computer simulations and analytical models (see Figure 13.1). While full-scale field exercises more closely replicate the real-life battlefield, they are also costlier and so a combination of field exercises and virtual training is often necessary.

A **Tactical Engagement Simulation (TES)** is a training system involving the use of weapons. Some common TES systems include the **F.A.T.S (Firearms Training Simulator)** used by the police and military and the **EST (Engagement Skills Trainer)** used by the U.S. Army (Figure 13.2). These simulations involve the use of various weapons and interactive screens displaying multiple scenarios in various environments. The systems provide marksmanship training, the simulation of police calls and stops, judgmental force continuum scenarios, rehearsal in calibrating weapons, and weapons qualification.

FIGURE 13.3 Screenshot of (a) *Bradley Trainer* (1980) and (b) an M2 Bradley Fighting Vehicle.



(a)

(b)

FIGURE 13.4 A close-up look at the (a) *MACS* rifle and generically labeled (b) *MACS* cartridge.

(a)

(b)

■ THE BRADLEY TRAINER

One of the earliest attempts to create a military training simulator based off a popular video game was based off of Atari's first-person tank combat arcade hit ***Battlezone*** in 1980. The U.S. **Army Training Doctrine and Command (TRADOC)** approached Atari "to turn its sci-fi shooter into a training simulator for the Army's latest infantry fighting vehicle, the **M2 Bradley**. Two *Army Battlezone* prototypes [also known as *Military Battlezone*] were eventually produced, but no Bradley crewman ever trained on the system" (Beekman, 2014, para. 3). Nothing became of the ***Bradley Trainer*** (Figure 13.3) prototypes, but the effort showed the military's interest in using video games for training and a WAN simulator called ***SIMNET*** would be later used for training in 1987 and into the 1990s.

■ MULTIPURPOSE ARCADE COMBAT SIMULATOR

Another military training device that used video game hardware and software was the ***Multipurpose Arcade Combat Simulator (MACS)***. Patented in 1986, a version of the *MACS* was developed for Super Nintendo around 1993 and remained a secret from the general public for over a decade until units began appearing for sale on the Internet. A complete set includes a replica Jäger AP 74 rifle and a cartridge by **Sculptured Software** (Figure 13.4). The rifle (which plugs into the SNES) includes a scope and has the look and feel of a real weapon. "While interest was primarily focused on its use as a rifle marksmanship trainer, *MACS* was designed so that the basic hardware could be used to provide training on a variety of weapons systems" (AusRetroGamer, 2016, para. 3). Three cartridge versions are thought to exist, and game/rifle bundles have sold online for upwards of $3,000.

■ MARINE DOOM

With the growing popularity of the **first-person shooter (FPS)**, the Marine Corps assigned Lieutenant **Scott Barnett** of its Modeling and Simulation Management Office with researching various PC games that could possibly be modified for Marine training purposes. Barnett settled on id Software's *Doom II* (1994) and "enlisted the help of Sgt. **Dan Snyder** to modify the game from its sci-fi Mars terrain to small desert village, and replace the game's demon enemies with more real-world adversaries" (Beekman, 2014, para. 4). The game focused on aggressive combat and cooperative teamwork and in 1996 ***Marine Doom*** (Figure 13.5) was authorized to be installed on government PCs. Marines were encouraged to play it, but the game never became an official military training instrument.

Following the *Marine Doom* initiative, in 1997 Marine Corps General **Charles C. Krulak** issued a directive supporting the use of computer games for 'Military Thinking and Decision Making Exercises' and "the stage was set for the Marine Corps and other branches of the military to work hand in hand with game developers" (Beekman, 2014, para. 5). Part of the rationale for simulated training includes availability of resources, financing, convenience, and accessibility. Beyond supplementary training, the purpose behind

FIGURE 13.5 Screenshots from *Marine Doom* (1996).

using video games has extended to include the recruitment of soldiers, and "most recently, to treat their psychological disorders, such as **PTSD [post-traumatic stress disorder]**" (Shaban, 2013, para. 5).

■ AMERICA'S ARMY

The principal title for recruiting soldiers is the online multiplayer, first-person shooter game ***America's Army*** (Figure 13.6), which was conceived by U.S. Army Chief Economist and Professor Colonel **Casey Wardynski** in 1999. The game was financed and developed by the United States Army using the **Unreal Engine** from **Epic Games** and the first iteration, subtitled *Recon*, was released for PC on July 4, 2002. Since its inception, the game has been available as a free download or can be installed from a free CD-ROM.

Following a virtual boot camp and marksmanship test, the game allows players to assume the role of various infantry-related jobs in the U.S. Army. Roles such as medic or sniper can be unlocked through multiple tiers of training. The title "quickly became the subject of criticism for targeting teenagers in its recruiting strategy; the game aimed to get high schoolers thinking about a career in the Army long before they turned 18. This controversy did not impact the game's massive popularity, and the project has continued, receiving 41 updates as of January 2014" (Beekman, 2014, para. 7). Tens of millions of users have registered *America's Army* accounts, which can be downloaded now on **Steam**.

■ FULL SPECTRUM WARRIOR

Another title commissioned by the U.S. military for training troops in four-person, squad-based fireteam scenarios was ***Full Spectrum Warrior (FSW)*** (Figure 13.7). This **real-time tactics (RTT)** game was created by the U.S. Army-funded **Institute for Creative Technologies (ICT)** in 2000 in collaboration with developer **Pandemic Studios** under the direction of **William Henry Stahl**. It was published by **THQ** (Toy Headquarters) on June 1, 2004. Gameplay revolves around the

FIGURE 13.6 Screenshots from the original *America's Army* (2002).

FIGURE 13.7 Screenshots from *Full Spectrum Warrior* (2004).

player issuing commands to Alpha and Bravo fireteams consisting of a team leader, rifleman, automatic rifleman, and grenadier. Because the game is not a first-person shooter, the player cannot directly control the fireteam members and first-person view is limited to issuing orders to squad members.

Both a commercial and an Army version of the game was produced; however, the Army only required around 2,000 copies when the minimum order for an Xbox game at that time was around 50,000 (Smith, 2016, para. 25). The solution was to bundle the initial Army version with the commercial version of the game which can be accessed by inputting a code on the Extras menu. A heavily modified version of the game is being used by the U.S. Army today "as a tool to help determine, in troops returning from war, the presence and severity of post-traumatic stress disorder" (Smith, 2016, para. 31).

Another real-time tactics game made specifically for military training purposes was ***Close Combat: Marines*** by **Atomic Games** in 2004. This computer game was based on the much-admired Avalon Hill board game ***Advanced Squad Leader (ASL).*** Like *FSW*, a commercial version of the game (*The Road to Baghdad*) was also released, in addition to multiple commercial releases over the years in the *Close Combat* series.

■ DARWARS

Long after *SIMNET*, another project sponsored by the U.S. **Defense Advanced Research Projects Agency (DARPA)** was ***DARWARS***. The project started in 2003 as a low-cost, mobile research program to aid in the advancement and usage of military training systems. *DARWARS* itself is not a game, but rather a scalable (adjustable) architectural framework for military instructors, which supports individual and team training on a **virtual battlefield**. This includes numerous tools, web services, and system interface definitions that allow for customized network training systems. These training systems track user progress and provide both individual and group feedback on performance.

Two widely used PC-based trainers of the *DARWARS* project include ***DARWARS Ambush!*** and the ***Tactical Language & Culture Training System***. *DARWARS Ambush!* (2004) (Figure 13.8) was a convoy simulator based off the commercial FPS game *Operation Flashpoint* (2001). It was developed by **BBN Technologies**, **Total Immersion Software**, and **Savage Entertainment**. The fully networked, multiplayer training simulator provided military training that could be customized to accommodate various experience levels. Lessons ranged from road-convoy-operations training, platoon-level mounted and dismounted infantry tactics, rules of engagement (ROE) training, and cross-cultural communications training. For example, one lesson might demonstrate how to anticipate and react to an ambush or how to handle an IED (improvised explosive device, i.e., bomb).

The key feature of *DARWARS Ambush!* was its user-authorability. Soldiers stationed around the world have been taught how to customize and add modifications to the game to simulate various scenarios that best fit their current location and mission. These modifications could

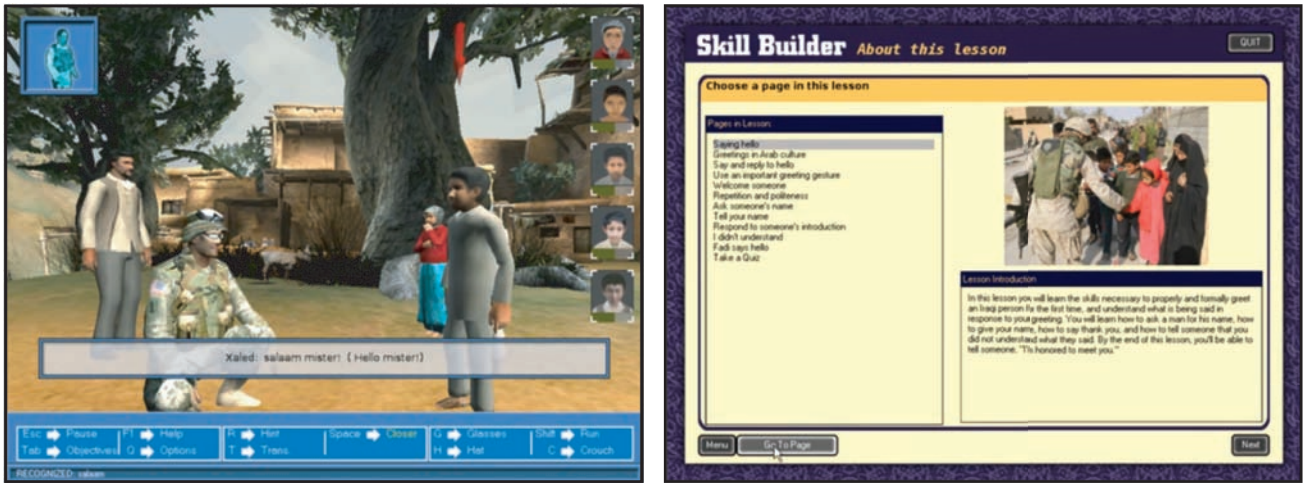
FIGURE 13.8 Screenshots of *DARWARS Ambush!* (2004).

include situations beyond combat, such as medical scenarios and cultural interaction (Crawford, 2009, p. 3). The game "continued to be enhanced, deployed, and utilized until a successor Army program, known as ***Game After Ambush [GAA]***, was deployed in 2009. Between 2004 and 2009, more than four thousand copies of the game were distributed, with Army, Air Force, and Marine units using the system at hundreds of installations" (Hussain and Coleman, 2014, p. 465).

The *Tactical Language & Culture Training System (TLCTS)* is still used today to teach both foreign languages and cultural knowledge for soldiers to effectively and safely conduct operations abroad. These self-paced courses include fully interactive 3D environments not unlike those in a video game. Students not only learn what to say, but also how and when such words and phrases are appropriate. An example of a *TLCTS* is ***Tactical Iraqi*** by **Alelo Inc.** (Figure 13.9), which "brought scenario-based PC gameplay to the 3rd Battalion, 7th Marines before their Surge deployment to Iraq in 2007. The game was developed to teach Iraqi situational language and gestures as well as cultural nuances in a virtual world that could be applied to real-world deployments" (Stilwell, 2016, para. 5).

These simulated *TLCTS* missions often run around 80 to 100 hours, reducing what could normally amount to several months of real-life cultural training. Numerous language and cultural programs are available free of charge to any member of the U.S. Armed Forces, including *Pashto, French*, and *Dari*. Both *DARWARS Ambush!* and the *Tactical Language & Culture* tutors have dramatically decreased the need for human trainers. However, to be completely effective, much of this training software must be properly administered by a

FIGURE 13.9 Screenshots of *Tactical Iraqi* (2007).



trained instructor, in the appropriate setting, with both training goals and **AARs (After Action Reviews)** (Chatham, 2006, p. 7).

■ VIRTUAL BATTLEFIELDS

The term "virtual battlefield" represents the digital simulation of a war environment, which is typically accomplished by combining several different features (such as weapons, screens, and vehicles) into the training area. One of the most prevalent virtual battlefield systems developed is the ***Virtual Battlespace*** series created by **David Lagettie** and *Operation Flashpoint* developer **Bohemia Interactive**. The original ***VBS1*** *(Virtual Battlespace 1)* was released to the United States Marine Corps (USMC) in 2001, followed by usage from the Australian Defence Force (ADF) in 2003 and a public release in 2004.

The system offered training for land, sea, and air vehicles and could even be customized to include the simulation of weather effects such as wind, rain, and fog. Instructors could create both lethal and non-lethal scenarios from multiple viewpoints, including the time of day, with sunrise, midday, or sunset lighting, and even customize high or low tides for ocean settings. *VBS1* even included data collection systems such as After Action Review (AAR) and Observer, as well as mission playback capability.

Bohemia Interactive Simulations (BISim) released ***VBS2*** in 2007 following close collaboration with the USMC, ADF, and other military users. It was this simulator that became the foundation for the *DARWARS Ambush!* successor *Game After Ambush* in 2009 (Shephard Press, 2013, p. 1). Based off the company's **Real Virtuality 2** engine, *VBS2* instructors can construct virtual battlefields over 10,000 square kilometers (3,900 sq mi) in size (Robson, 2008, para. 22) and then populate the terrain area with millions of texture-mapped objects built from real satellite imagery and/or aerial photography. View distances were improved to produce draw distances up to five times greater than *VBS1*.

Another prominent virtual battlefield system used today is the ***VIRTSIM*** system (Figure 13.10a) by **Raytheon Company** and **Motion Reality Inc. (MRI)** in 2012. The program uses virtual immersion simulation technology that uses reflective markers for full-motion body capture, including **virtual reality (VR)** headsets, weapon props, and even shock-feedback when a user gets hit (Lang, 2012, para. 1). Engagement takes place along a basketball court-sized game space with up to 13 participants.

The third iteration of *Virtual Battlespace*, ***VBS3***, was released to the U.S. Army in 2014. Terrain size increased to up to 4,000,000 square kilometers and the program uses a "**human dimension modeling**" system to create an **avatar** based on the soldier's actual appearance and abilities. In other words, the user's "avatar looks, shoots, moves through terrain and gets fatigued just like its operating soldier. It takes a soldier's fitness rating and factors it into the system to affect the avatar's performance. It mirrors not only height and weight, but things like marksmanship and PT scores" (Barrie, 2014, para. 2).

Newer simulators include ***TitanIM*** by **Outerra** (December 2014) which "is capable of recreating planet-wide environments from ocean floors to Earth's orbit at equally high fidelity for any point between. Using the powerful Outerra rendering engine, blades of grass and dirt roads are as eye-pleasing as in any major video game,

FIGURE 13.10 Players using (a) *VIRTSIM* and (b) BISim Co-CEO Pete Morrison on *VBS Blue*.

(a)

(b)

yet the view from 50,000 feet altitude is suitable for a high-end simulator" (TitanIM Pty Ltd., 2017). Unlike older platforms with limited map space, *TitanIM* integrates air, land, sea, and space into one seamless, uninterrupted experience. Likewise, BISim's ***VBS Blue*** (2015) (Figure 13.10b) features whole-earth rendering technology representing the entire planet and a VR-based F/A-18 Hornet flight simulator created under contract for the U.S. Navy.

■ AT EASE

Thanks in part to the popularity of video games, computer technology has become an integral part of military training and operations today. As defense budgets dwindle, virtual simulation technology will progressively allow military units to train at a significantly reduced cost, along with a reduction in the physical exhaustion of its real-life equipment and vehicles, including the soldiers themselves.

After the battle, simulation software can also be used to help soldiers with post-traumatic stress disorder (PTSD). By immersing soldiers in an interactive virtual environment "with the help of clinicians in controlled settings, soldiers are able to confront traumatic memories in a process called **exposure therapy**. By recalling distressing episodes from their past, soldiers learn to habituate themselves to those fearful experiences. Games help them manage their negative emotions and troubled thoughts" (Shaban, 2013, para. 15). Such therapy can help soldiers with self-reflection and the development of a more positive outlook on life. Recent studies have also shown positive results in the treatment of mental illness.

■ VIDEO GAMES IN SCIENCE

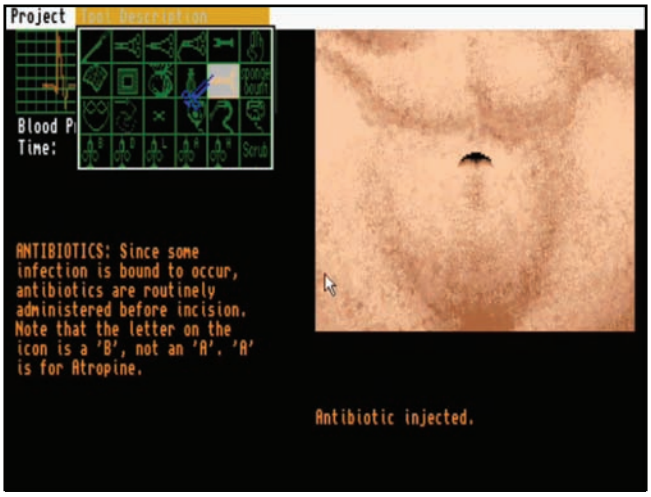
Like the military, more scientists and doctors are using interactive technology each day for training and research initiatives. With motion technology, many games are now being used as physical fitness applications, such as with rehabilitation programs in hospitals and nursing homes. There are also countless studies being done on the physical and psychological effects of video games on the brain. This section focuses on the numerous ways video games have been used by the scientific and medical communities. It will also look at some of the recent studies on the effects of playing video games.

■ SERIOUS GAMES

Serious games, also known as "applied games," are games designed with a purpose other than to simply entertain. These are typically simulation-style games like those used by the military, which can also be used for training individuals in the medical and science professions. With the improved graphics and functionality of computers in the 1980s, medically oriented simulation software began to appear.

Information Systems for Medicine developed a game in 1986 called *The Surgeon* (Figure 13.11a) for Macintosh and Amiga which accurately simulated procedures such as operating on an aortic aneurysm (Boosman, 1986, p. 42). Another commercial release on multiple computer platforms was *Life & Death* by **The Software Toolworks** in 1988 (Figure 13.11b). Players

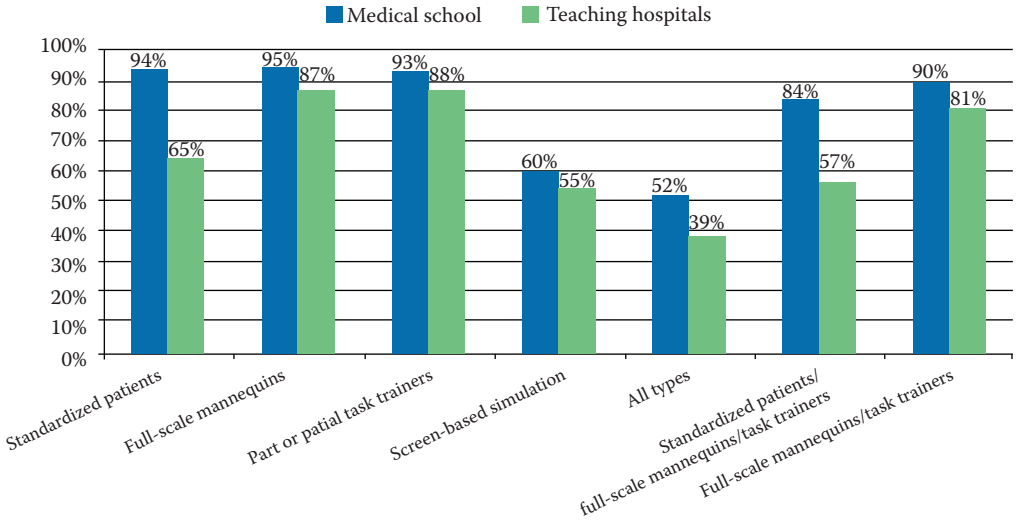
FIGURE 13.11 Screenshots of the *The Surgeon* (a) and *Life & Death* (b).



(a)

(b)

FIGURE 13.12 Types of simulation used in medical education (AAMC, 2011, p. 28).



assumed the role of a resident abdominal surgeon at the fictional "Toolworks General Hospital" and gameplay involved diagnosing and treating everything from kidney stones, to arthritis and appendicitis, in addition to performing virtual surgery.

High-fidelity programs emerged in the 1990s and by the end of the century a number of noncommercial simulation products were being developed for the medical community. In 2004, the **Society for Simulation in Healthcare (SSH)** (formerly known as the Society for Medical Simulation) was created to advance medical simulation technology in healthcare. Today both medical schools and teaching hospitals are using medical simulation for training healthcare professionals. Known as **Clinical Skills and Simulations Centers (CSSCs)**, "their simulation training is an essential link between medical student training and clinical experience and has proven to be an effective tool for assessing technical skills, critical thinking, and team-orientated behavior throughout medical training" (Tufts University School of Medicine, 2016, para. 1). Figure 13.12 shows simulation usage from 2011. Today these percentages are even greater.

Similar to how the military combines modified artillery and vehicular components with computer software in the creation of their simulation products, medical simulation typically employs a combination computer application with full-scale computerized mannequins and smaller partial task trainers called **high-fidelity patient simulations (HPS)**. As early as 2011, nearly all medical schools and teaching hospitals were using full-scale mannequins, and more than half contained screen-based simulation as part of their training operations. Examples of screen-

FIGURE 13.13 *Ultrasound Simulator.*

TABLE 13.1 Commercially Available Medical Simulation Titles

Ben's Game	Life & Death II: The Brain	Surgeon
Big Pharma	LifeSigns: Surgical Unit	Science Sleuths
Bronkie the Bronchiasaurus	Microsurgeon	SimHealth
Captain Novolin	Packy and Marlon	Sneeze
The Gekai	Plague Inc.	Surgeon Simulator 2013
Hospital Hustle	Plague Inc: Evolved	Theme Hospital
Hospital Tycoon	Plaque Attack	Trauma Center (series)
Immune Attack	Playnormous	Trauma Team
Life & Death	Rex Ronan: Experimental	

based medical simulations include *ACLS Simulator, Anatomy Module, Anesthesia SimSTAT, CardioSim, MicroEKG, Neonatal Simulator, Ultrasound Simulator* (Figure 13.13), and *Virtual Dental Implant Trainer*.

There is also evidence that suggests gamers may make better surgeons. A study in 2007 by Dr. **James Rosser Jr.** and colleagues showed a positive correlation between surgical residents and medical students who played video games and their laparoscopic surgery skills. In fact, "Dr. Rosser's study found that surgeons who had played video games in the past for more than three hours per week made 37 percent fewer errors, were 27 percent faster, and scored 42 percent better on laparoscopic surgery and suturing drills than surgeons who never played video games" (Hampton, 2013, para. 5). See Table 13.1 for a list of commercially available medical simulation titles.

■ SERIOUS GAMES SHOWCASE AND CHALLENGE

The **Serious Games Showcase and Challenge** is a competition and showcase event created to encourage the development of serious games. The organization was founded in 2005 when military coalition **Team Orlando** formed a partnership with the **National Training Simulation and Association (NTSA)** and the **Interservice/Industry Training, Simulation and Education Conference (I/ITSEC)**. Their goal was "to stimulate industry creativity and generate institutional interest toward the use of digital game technology and approaches for training and education" (Serious Games Showcase & Challenge, 2012, para. 1). The event made its debut in 2006 and each year the group awards the best serious games in the categories such as business, government, mobile, and social media (Table 13.2).

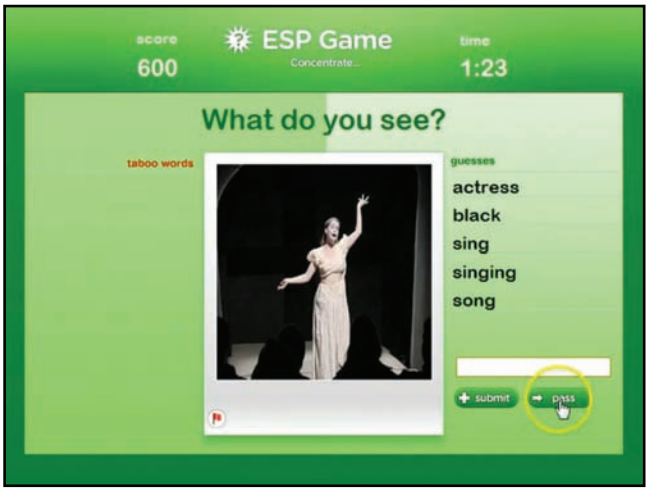
■ GAMES WITH A PURPOSE

Another genre of video games used in the scientific community is known as the human-based computation game or "**game with a purpose**" **(GWAP)**. Based on the "human computation" concept of Dr. **Luis von Ahn**, the idea behind these games is to harness human brainpower with computer programs to find solutions that neither may have been able to discover separately. The concept of amateur scientists working on such solutions is known as **citizen science** or **crowd-sourced science**. Vo Ahn's first game to utilize this idea was the ***ESP Game*** (short for Extra Sensory Perception) (Figure 13.14a). The game created to improve the World Wide

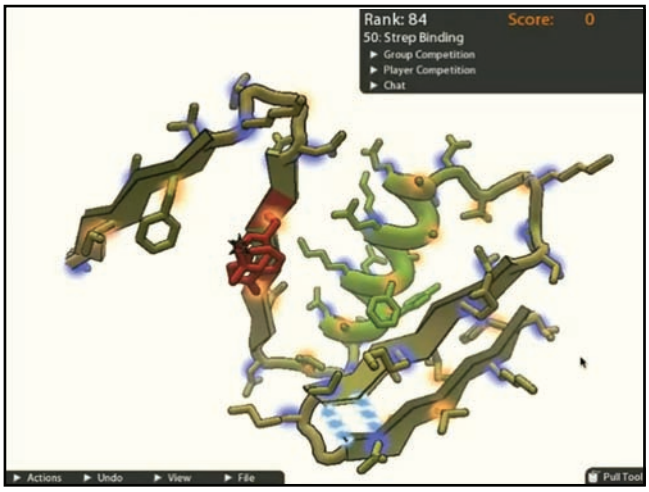
TABLE 13.2 Serious Games Showcase and Challenge 2015 Award Winners (SGSC, 2016)

Category	**Game Title, Developer**
Best Business Game	*Project Desal,* Monkeystack (also SimTecT winner)
Best Government Game	*MUM-T Strikeforce,* U.S. Army PdM –TUAS
Best Student Game	*Healthx,* University of Utah
Best Mobile Serious Game	*Project Desal,* Monkeystack
Best SM Crowdsourcing Game	*Unsavory,* University of Miami
Students' Choice	*Particle in a Box: The Quantum Mechanics Game,* Georgia Institute of Technology
People's Choice	*MUM-T Strikeforce,*U.S. Army PdM –TUAS

FIGURE 13.14 Screenshots of the *ESP Game* (a) and *Foldit* (b).



(a)



(b)

Web "reveals the same image to two players and asks each to guess what the other person has written to describe it. If they agree, that word or phrase is then used to annotate the picture. Repeating the same image with other pairs of players, the computer eventually builds up a detailed label" (Saini, 2008, para. 5). The program was licensed to Google who developed its own version of the program called ***Google Image Labeler*** in 2006.

A second example of how GWAPs can lead to scientific discovery was the 2011 breakthrough on the Mason-Pfizer AIDS-causing monkey virus (M-PMV). An unsolved problem for approximately 15 years was solved after just 10 days of concentrated effort by a group predominantly consisting of gamers playing the title ***Foldit*** (2008) (Figure 13.14b). In the game, "players have to manipulate 3D shapes to create a solution to a pre-identified problem. The 3D shapes are in fact proteins and the potential solutions are ones that science is seeking in real life" (Rawlings, 2016, para. 1). *Foldit* is estimated to have reached over a quarter million players by 2013 and continues to be an important contributor in protein folding research for the treatment of AIDS, cancer, and Alzheimer's Disease.

In ***EteRNA*** (2011), players "are given a real-world RNA [ribonucleic acid] shape and asked to manipulate a chain of nucleotides to fit that shape, by observing how different patterns of nucleotides form certain structures, like loops or tails. Then, every week, a few molecules are selected for synthesis in a lab at Stanford to see how closely they match the desired shape" (Dunning, 2012, para. 2). In just 3 years and with the help of more than 37,000 citizen scientists, *EteRNA* has already helped generate a more accurate algorithm for predicting RNA folding (Olena, 2014, para. 1).

Other popular GWAP titles include *Eyewire*, which combines coloring and treasure hunting to assist scientists in deciphering how the brain is wired; *Phylo*, where arranging colored blocks to swinging jazz music can help with genetic disease research in animals; and NASA's *Be a Martian*, where players participate as citizen scientists to assist real science teams in studying data about planet Mars. See Table 13.3 for even more influential "Games With a Purpose."

■ VIDEO GAME RESEARCH

Beyond using video game technology for medical training and scientific research, a number of scientists and researchers have been studying the effects and benefits of video games on its players. This section will review current research that looks at video game effects on the human brain, in addition to ways this interactive medium is being used for physical, social, and mental development. For more coverage on the effects of stereotypes and video game violence, see *Chapter 7: Sex and Violence Take Center Stage.*

■ NEGATIVE SIDE EFFECTS

For the first couple of decades since the early 1990s, the majority of studies being conducted on the effects of video games were focused on their possible negative side effects. Researchers have sought to discover whether video games could lead to violent and/or antisocial

TABLE 13.3 Thirty of the Most Influential "Games with a Purpose"

• Apetopia	• Galaxy Zoo	• Play to Cure: Genes in Space
• Artigo	• Happy Match	• Quantum Moves
• Be a Martian	• JeuxDeMots	• Reverse The Odds
• Cropland Capture	• MalariaSpot	• Sea Hero Quest
• ESP game	• Mark With Friends	• Smorball
• EteRNA	• Nanocrafter	• Tag a Tune
• Eyewire	• Nanodoc	• Train Robots
• Foldit	• OnToGalaxy	• Verbosity
• Forgotten Island	• Phrase Detectives	• Whale FM
• Fraxinus	• Phylo	• Worm Watch Lab

behavior, and whether extensive game playing could lead to other negative effects on one's health or psyche.

In 2015, Dr. **Mark Appelbaum** of the American Psychological Association (APA) concluded that data from over 300 studies between 2005 and 2013 showed a consistent relationship between playing violent video games and an increase in aggressive behavior, "but insufficient evidence exists about whether the link extends to criminal violence or delinquency" (APA, 2015). In contrast, Dr. Cheryl Olson and her team at Harvard/Mass General Hospital have found violent games to be an outlet for stress and aggression.

Another possible negative side effect of video games is **desensitization**. A study by Dr. **Alessandro Gabbiadini** from the University of Milano Bicocca with The Ohio State University professor Dr. **Brad Bushman** and others suggested that "young male gamers who strongly identify with male characters in sexist, violent video games show less empathy than others toward female violence victims" (Grabmeier, 2016, para. 1).

Video game addiction has also become a reality for certain individuals, particularly for players of games that never end, such as in massively multiplayer online (MMO) titles. Researchers at Stanford University School of Medicine have found evidence that video games possess addictive characteristics. Clinical psychologist and founder of Computer Addiction Service Dr. **Maressa Hecht Orzack** has claimed that as many as 40% of gamers playing *World of Warcraft* have been addicted to the game (Dale and Lewis, 2016, p. 495). Numerous countries such as South Korea, China, the Netherlands, Canada, Australia, and the United States have established addiction centers specializing in video game addition.

While further research is necessary to determine all the risk factors for video games to cause aggressive behavior or addition, excessive video game playing (like any other activity) can certainly disrupt a person's social life, school and/or work priorities, along with one's physical health. Too many hours in front of any screen without enough physical activity can result in serious health problems, such as obesity and even death in some instances. While small in number, there have been reports of gamers such as **Chen Rong-Yu** of New Taipei (2012) who were found dead after playing video games for more than 20 consecutive hours. The cause of death on these occasions is often cardiac arrest.

■ POSITIVE IMPACT

Aside from the possible negative side effects of violent games or simply playing too much, many recent studies have uncovered a number of hidden benefits to playing video games. From improved reaction times and better hand-eye coordination, motor skill development with motion games, to problem solving skills and emotional fulfillment, playing video games might be more beneficial than many people have ever considered.

One study in Proceedings of the National Academy of Sciences (PNAS) by research associate at Princeton University Dr. **Vikranth Bejjanki**, et al. (2014) found that "action video game play results in enhanced perceptual templates and does so by facilitating the rapid learning of task relevant statistics" (p. 16964). In other words, playing fast-paced, action-oriented games may improve gamers' performance in real-world perception, attention, and cognition.

Another study involved University of Geneva professor Dr. **Daphne Bavelier** comparing the visual tracking abilities between gamers and non-gamers. One of the tests challenged subjects to keep track of the positions of multiple moving objects. The results found that individuals who played action video games

performed markedly better than those participants who did not (BBC News, 2015, p. 2). Bavelier's work has also shown gamers to be much more proficient than non-gamers at the **Stroop Effect test** where subjects are shown colors written as words such as **RED**, **BLUE**, **YELLOW**, and asked to quickly identify the color of each word without confusing the color with the written word.

Cyberpsychologist **Berni Good** has synthesized research from across the globe in studying video games' effects on personal well-being. Good's research has shown a positive correlation with gaming and **Self Determination Theory (SDT)** whereby players can address three psychological needs through playing games: the need to feel competent, the need to relate to others in a meaningful way, and the need for autonomy—being in control of one's destiny (Wells, 2016, para. 15–20).

Virtual reality therapy (VRT) like the customizable **SECTER** (Simulated Environment for Counseling, Training, Evaluation and Rehabilitation) program is now being used to treat everything from anxiety, to eating disorders and Asperger's syndrome (Frenkel, 2009, p. 1). In place of traditional therapy, patients log into these programs to communicate with therapists in a 3D virtual space using avatars. SECTER avatars can assume various human postures and facial expressions, and sessions often involve role-playing as part of therapy. Such programs have proved quite successful for patients who would otherwise have difficulty working with a counselor in a face-to-face environment.

■ BRAIN DEVELOPMENT

Max-Planck Institute of Human Development instructor **Simone Kühn** has researched the effects of video games on the human brain using "fMRI (functional MRI) technology to study the brains of subjects as they played *Super Mario 64 DS*, over a period of two months. Remarkably, she found that three areas of the brain had grown—the prefrontal cortex, right hippocampus and cerebellum—all involved in navigation and fine motor control" (BBC News, 2015). The combination of navigating the 3D world on the top screen with a 2D map on the lower screen is thought to be a key facilitator of the stimulated brain growth.

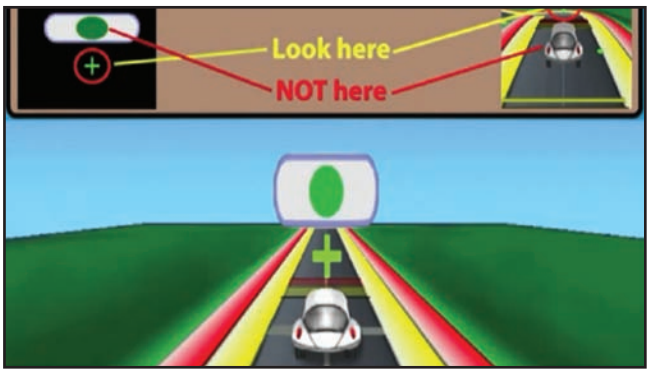
University of California, San Francisco, professor Dr. **Adam Gazzaley** and a team of video game designers developed a game called ***NeuroRacer*** (Figure 13.15) that has shown to be able to improve older players' ability to multitask. The game "requires individuals to steer a car while at the same time performing other tasks. After playing the game for 12 hours, Prof. Gazzaley found pensioners had improved their performance so much they were beating 20-year-olds playing it for the first time. He also measured improvements in their working memory and attention span" (BBC News, 2015). Even more importantly, there is evidence that skills developed from the game can be utilized in the real world.

■ FROM SCIENCE TO EDUCATION

As far back as 1994, New York Times best-selling author **David Sheff** claimed that "by playing video games children gain problem solving abilities, perseverance, pattern recognition, hypothesis testing, estimating skills, inductive skills, resources management, logistics mapping, memory, quick thinking and reasonable judgments" (Sheff, 1994, p. 33). With the many recent positive studies showing the potential of interactive media for improving mental tasks and brain development, video games and computer simulations are being used in a variety of ways today to educate both children and adults.

FIGURE 13.15 Dr. Gazzaley with Ann Stewart (67) (a) playing *NeuroRacer* and screenshot (b).

(a)



(b)

FIGURE 13.16 Strategix bus simulator for pre-employment driving assessment (a) and CAE full-flight simulator of an Airbus A320 cockpit (b).

(a)

(b)

Like the military and medical community, industries from ground transportation to aviation training are also using interactive technology for training employees. There is "the opportunity to develop transferable skills, or practice challenging or extraordinary activities, such as **flight simulators**, or [other] simulated operations" (Griffiths, 2014, para. 9). These virtual environments can provide a safe place to make mistakes and learn from failure, and can often be more engaging or entertaining than traditional training methods. Figure 13.16 illustrates some examples of how interactive technology is being used in educational training with simulation software programs.

Interactive media provides the experience of novelty, curiosity, and challenge that can stimulate learning and the educational possibilities of this medium are only beginning to be explored. For instance, simulation games are now being used in economics courses to provide an assortment of chance, skill, and strategy that replicates real-world scenarios like the New York stock exchange and other forms of competition.

Life simulation applications or **virtual worlds** like ***Second Life*** have been used for numerous educational purposes, from the University of San Martin de Porres of Peru's prototypes of Peruvian archeological buildings, to American Chemical Society's *ACS Island*, and Nature Publishing Group's *Elucian Islands Village* populated with labs for scientists and educators to conduct their own work free of charge. Other spaces have been used for virtual classrooms and museums, as well as interactive maps as shown in Table 13.4.

Educational games can also be an effective motivational tool in the classroom. As Michigan State University professor Dr. **John L. Sherry** explains, "the right video games help children master everything from basic grammar to complex math without the drudgery of old-school flash cards. Many games require kids to anti-

TABLE 13.4 Five Science Education Areas in Second Life (Knop, 2008)

Area	Description
Weather Map at the Science School	An interactive weather map from National Oceanic and Atmospheric Administration at the University of Denver
The 'splo	A virtual extension of San Francisco's *Exploratorium* science museum with displays and exhibits on observing the world
Genome Island	Texas Wesleyan University's exhibits on genetics, inheritance, and molecular and cell biology
The International Spaceflight Museum	Scale models of rockets from countries around the world, such as the Apollo lunar command and lander modules
History of Earth Walking Exhibit	A walking tour through 4.6 billion years of Earth's history, designed by students from the University of Arizona

FIGURE 13.17 Notable educational titles on the Nintendo DS: (a) *Art Academy*, (b) *Big Brain Academy*, (c) *Brain Age²: More Training in Minutes a Day*, and (d) *My Word Coach*.

(a) (b) (c) (d)

cipate movements and, in the case of three-dimensional video games, require players to manipulate objects through a three-dimensional place" (Weber, 2017, para. 4). These 3D environments more closely replicate real-world scenarios and can improve spacial-relationship skills.

Gameplay that has defined learning outcomes is known as **game-based learning (GBL).** Game-based learning is generally "designed to balance subject matter with gameplay and the ability of the player to retain and apply said subject matter to the real world" (EdTechReview, 2013, para. 1). This form of learning is typically facilitated by a teacher who adds depth and perspective to the experience. This is different from **gamification**, which borrows incentives from video games (like points, achievements, and other rewards) and uses them in a non-game setting such as the classroom or for research and crowdsourcing purposes like how the science community gamified *Foldit.* For educational video games, most teachers use **commercial off-the-shelf (COTS)** titles.

■ POPULAR COTS EDUCATIONAL GAMES

Educational video games have been around since video games became popular in the late 1970s and early 1980s. **The Learning Company** was known for its *Reader Rabbit* series which began in 1983, in addition to its *Zoombinis* (1996) franchise and *The ClueFinders* series which launched in 1998. **Knowledge Adventure** was popular for its *JumpStart* franchise and *Blaster Learning System* (originally by Davidson) series, which both debuted in 1994. Other big names in educational software from the 1990s included **GCompris**, **Disney Interactive**, and **PBS Kids** which was introduced in 1999.

The new millennium saw a flood of educational games such as **LeapFrog Enterprises' LeapPad** which first released in 1999. The children's tablet contained an **electrographic sensor** for interactive, touch-sensitive books. This was followed by a cartridge-based handheld game system called **Leapster** in 2003 and the **Nintendo DS** handheld in 2004. The Apple **iPad** released six years later in 2010 and mobile devices quickly became popular platforms for commercial off-the-shelf educational titles. Often referred to as "**edutainment**" games, titles like *Brain Age* (2006) and *Art Academy* (2011) (shown in Figure 13.17) have ranked particularly well—attracting both young and older gamers alike.

More schools are replacing traditional blackboards for **Smart Boards** and almost all schools provide some kind of curriculum on computer literacy. A nationwide study from NYU and University of Michigan researchers found that over half of 488 K–12 teachers in the United States were using digital games in class on a weekly basis (The A-Games Project, 2016). Most of these teachers were from grades K through five, with 40% or more of

FIGURE 13.18 Percentage of digital game use by grade.

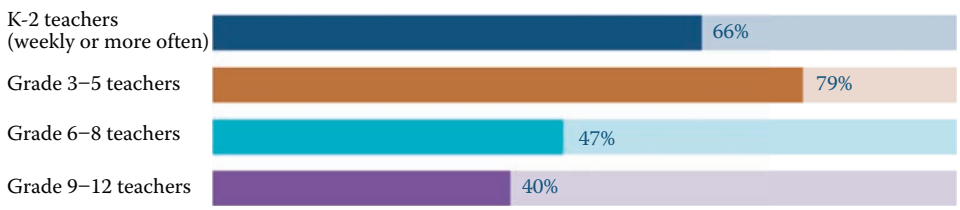


TABLE 13.5 Popular Educational Video Game Websites

Resource	Description	Website
ABCya	Pre-K to grade 5	www.abcya.com
Education.com	Over 300 games	https://www.education.com/games
FunBrain	K through grade 8	https://www.funbrain.com
Learning Games For Kids	Games by subject	www.learninggamesforkids.com
PBS Kids	Cartoon-based games	pbskids.org/games

teachers in grades 6–12 reporting video game usage in the classroom as shown in Figure 13.18.

Educational video games provide more immediate feedback to both the student and teacher, while teaching a systematic way of thinking as well as an understanding for how different variables affect each other (Tannahill, Tissington, and Senior, 2012, pp. 1–2). Many of these games are available for free from online platforms such as Norway's ***Kahoot!*** launched in 2013. *Kahoot!*, which has over 50 million users, "enables anyone to create their own game-based educational content, and helps to found new types of classrooms in which to best exploit it" (Collins, 2015, para. 1–2). **Disney Junior** and **Nick Jr.** also feature educational games on their websites featuring popular cartoon characters. See Table 13.5 for more.

One of the most commercially successful COTS titles to have been applied in classrooms across the globe is Mojang's ***Minecraft*** which debuted in 2011. The sandbox title involves constructing virtually anything out of textured cubes in a 3D world. Players mine resources and then use them to build anything from cabins to castles—and from islands to entire continents. More than 7,000 classrooms around the world are estimated to have used *Minecraft* in one form or another, from courses on the arts to STEM (science, technology, engineering and mathematics) programs. *Minecraft: Education Edition* (formerly *MinecraftEdu*) was released in 2016, adding a camera and portfolio for students to take screenshots and document their work, in addition to allowing them to download the software outside of school to continue their class work free of charge.

While the current research on video games and learning has been generally positive, there have not been enough studies to conclusively determine whether educational video games (Table 13.6) actually improve academic performance. Video games have proven to be an effective motivational tool to stimulate learning and students can certainly develop game-specific skills, but how much these abilities transfer into the classroom or real-world remains in the hands of future studies.

■ SCHOOLS SPECIALIZING IN GAMING

Designed by **Institute of Play,** the New York-based **Quest to Learn** is a middle school and high school launched in 2009 that bases its curriculum on game theory and game mechanics. "Students create virtual worlds in the online game *Minecraft*, communicate over

TABLE 13.6 Top Educational Video Games Over the Decades from A to Z

Art Academy	History of Biology game	Oregon Trail
Big Brain Academy (series)	I.M. Meen	PlaceSpotting
Bot Colony	Immune Attack	Quest Atlantis
Brain Age (series)	InLiving	Reader Rabbit
Carmen Sandiego (series)	JumpStart (series)	Reading Blaster
The ClueFinders	Ko's Journey	Storybook Weaver
EcoQuest (series)	Magic School Bus (series)	Swamp Gas Visits the USA
Food Force	Math Blaster (series)	Tuxmath
GCompris	Meister Cody	The Typing of the Dead
Genomics Digital Lab	Minecraft	Urban Jungle
Get Water!	My Word Coach	WolfQuest
Gizmos & Gadgets	NoteBlaster	Word Munchers
Gus Goes to Cybertown	Number Munchers	Zoombinis

an in-house social network, and learn about Pi by stepping into an immersive digital environment that is controlled by a dozen or so infrared cameras that are tacked to the classroom walls" (Sutter, 2012, p. 2). The school is so immersed in gaming that letter grades have been replaced by ranking terms such as "novice" and "expert" and final exams are referred to as "boss levels." A second "Quest" high school, **CICS ChicagoQuest**, opened in Chicago in 2011.

As for video game-specific curriculums, the ESA reported that during the 2015–16 academic year, a record 406 American colleges, universities, and technical schools offered "programs in video game-related topics" (Entertainment Software Association, 2017). Furthermore, **The Princeton Review** (also known for its test preparation programs for the SAT and other exams) compiles annual rankings of colleges, business and law schools in dozens of categories that it reports on its website and in print publications. Since 2010, the company has published ranking lists for the top schools for studying game design as shown in Table 13.7.

■ FINAL EXAMINATION

Interactive technology has come a long way in a relatively short amount of time. From their earliest years, computer games have been examined and eventually utilized by the military, science and medical communities, and educational institutions across the globe. While more research is needed to fully comprehend the effects and benefits of this technology, one thing is for certain: it is being used right now by all of these industries and shows no signs of slowing down.

TABLE 13.7 The Princeton Review's "Top 25 Schools to Study Game Design" (2017)

Rank	Undergraduate Programs	Graduate Programs
1	University of Southern California (Los Angeles)	Southern Methodist University (Plano, TX)
2	Rochester Institute of Technology (NY)	University of Central Florida (Orlando, FL)
3	University of Utah (Salt Lake City)	University of Utah (Salt Lake City, UT)
4	DigiPen Institute of Technology (Redmond, WA)	Rochester Institute of Technology (Rochester, NY)
5	Becker College (Worcester, MA)	University of Southern California (Los Angeles, CA)
6	Hampshire College (Amherst, MA)	New York University (Brooklyn, NY)
7	New York University (Brooklyn, NY)	DigiPen Institute of Technology (Redmond, WA)
8	The Art Institute of Vancouver (British Columbia)	Drexel University (Philadelphia, PA)
9	Drexel University (Philadelphia, PA)	Abertay University (Dundee, Scotland)
10	Michigan State University (East Lansing, MI)	DePaul University (Chicago, IL)
11	Vancouver Film School (British Columbia)	Michigan State University (East Lansing, MI)
12	Bradley University (Peoria, IL)	Worcester Polytechnic Institute (Worcester, MA)
13	Northeastern University (Boston, MA)	University of California at Santa Cruz (Santa Cruz)
14	Champlain College (Burlington, VT)	The University of Texas at Dallas (Richardson, TX)
15	University of Wisconsin-Stout (Menomonie, WI)	Savannah College of Art and Design (Savannah, GA)
16	Worcester Polytechnic Institute (Worcester, MA)	American University (Washington, DC)
17	The University of Texas at Dallas (Richardson, TX)	Texas A&M University (College Station, TX)
18	DePaul University (Chicago, IL)	Sacred Heart University (Fairfield, CT)
19	Abertay University (Dundee, Scotland)	The Ohio State University—Columbus
20	Ferris State University (Big Rapids, MI)	University of Wisconsin - Stout (Menomonie, WI)
21	University of California - Santa Cruz (Santa Cruz)	Full Sail University (Winter Park, FL)
22	Shawnee State University (Portsmouth, OH)	Massachusetts Institute of Technology (Cambridge)
23	Cogswell College (San Jose, CA)	University of Malta (Msida, Malta)
24	Savannah College of Art and Design (GA)	University of Pennsylvania (Philadelphia, PA)
25	Miami University (Oxford, OH)	University of Miami (Coral Gables, FL)

■ ACTIVITY: FURTHER RESEARCH

Option 1: Research and conduct a SWOT analysis on one of the following military simulation programs that were not discussed in this chapter:

- Cubic I-MILES - https://www.cubic.com/Global-Defense/Training-Solutions
- JANUS - http://www.janusresearch.com/Virtual-Environment-Training
- Laser Shot - https://www.lasershot.com/
- VirTra: Firearms Training Simulator - http://www.virtra.com/

Option 2: Play and conduct a SWOT analysis on one of the medical simulation games or educational titles listed in Tables 13.1 through 13.6:

- Table 13.1 Commercially Available Medical Simulation Titles
- Table 13.2 Serious Games Showcase and Challenge 2015 Award Winners
- Table 13.3 Thirty of the Most Influential "Games With A Purpose"
- Table 13.4 Five Science Education Areas in *Second Life*
- Table 13.5 Popular Educational Video Game Websites
- Table 13.6 Top Educational Video Games Over the Decades from A to Z

■ CHAPTER 13 QUIZ

1. Which of the following military simulations is more on the end of operational realism (rather than increased abstraction)?
   a. Field exercises
   b. Map exercises
   c. Computer simulations
   d. Analytical models

2. Two military training simulators that never became official military training instruments:
   a. Battlezone and SIMNET
   b. SIMNET and Military Doom
   c. Military Doom and Battlezone
   d. None of the above

3. The principal title that the U.S. Army has used for recruiting soldiers is the online multiplayer, first-person shooter game:
   a. Multipurpose Arcade Combat Simulator
   b. Marine Doom
   c. America's Army
   d. Full Spectrum Warrior

4. This four-person, squad-based real-time tactics (RTT) game is still used today for troops returning from war to help determine the presence and severity of PTSD:
   a. Multipurpose Arcade Combat Simulator
   b. Marine Doom
   c. America's Army
   d. Full Spectrum Warrior

5. Two widely used PC-based trainers of the *DARWARS* project included:
   a. DARWARS Ambush! and Tactical Language & Culture Training System
   b. SIMNET and DARWARS Ambush!
   c. Tactical Language & Culture Training System and SIMNET
   d. DARWARS Ambush! and Multipurpose Arcade Combat Simulator

6. *Virtual Battlespace (VBS1)* offered training for land, sea, and air vehicles and could even be customized to include the simulation of:
   a. Weather effects such as wind, rain, and fog
   b. Lethal and non-lethal scenarios
   c. Time of day, with sunrise, midday or sunset lighting
   d. All of the above

7. This program uses virtual immersion simulation technology that uses reflective markers for full-motion body capture, including virtual reality (VR) headsets, weapon props, and even shock-feedback when a user gets hit:
   a. DARWARS Ambush!
   b. Real Virtuality 2
   c. *VIRTSIM*
   d. *Virtual Battlespace 3 (VBS3)*

8. Immersion in an interactive virtual environment where soldiers can confront traumatic memories with the help of clinicians in controlled settings is called:
   a. High-fidelity patient simulation
   b. Exposure therapy
   c. Desensitization
   d. Stroop effect

9. These games are designed with a purpose other than to simply entertain:
   a. Serious games
   b. Human-based computation games
   c. Games with a purpose (GWAP)
   d. All of the above

10. High-fidelity patient simulations (HPS):
    a. employ a combination computer applications with high tech mannequins
    b. use full-scale computerized mannequins but not screen-based simulation
    c. are solely screen-based computer simulation programs
    d. do not include smaller partial task trainers such as specific body parts

11. Video games used in the scientific community known as "human-based computation" games or "_____" harness human brainpower with computer programs to find solutions to scientific problems:
    a. Games for Life
    b. Games with Goals
    c. Games with a Mission
    d. Games with a Purpose

12. The concept of amateur scientists working on solutions to real scientific problems is known as "citizen science" or "crowd-sourced science." Which of the following games does *not* fit into this category?
    a. ESP Game
    b. EteRNA
    c. Foldit
    d. The Surgeon

13. This game was licensed to Google who developed its own version of the program called *Google Image Labeler* in 2006:
    a. ESP Game
    b. EteRNA
    c. Foldit
    d. The Surgeon

14. This title led to a scientific breakthrough on the Mason-Pfizer AIDS-causing monkey virus (M-PMV) in 2011:
    a. ESP Game
    b. EteRNA
    c. Foldit
    d. The Surgeon

15. Negative side effect(s) linked to violent or excessive gaming:
    a. Desensitization
    b. Video game addiction
    c. Death
    d. All of the above

16. Princeton University's Dr. Vikranth Bejjanki found that playing fast-paced, action-oriented games may improve gamers' performance in the real world:
    a. Perception
    b. Attention
    c. Cognition
    d. All of the above

17. Gamers were found to be much more proficient than non-gamers at this test where subjects are shown written as words such as RED, BLUE, YELLOW in various colors and asked to quickly identify the color of each word without confusing the color with the written word:
    a. NeuroRacer
    b. SECTER test
    c. Stroop effect test
    d. Color autonomy test

18. Gameplay that has defined learning outcomes is known as:
    a. Curricular off-the-shelf (COTS)
    b. Edutainment
    c. Game-based learning (GBL)
    d. Gamification

19. Which of the following games does *not* fit into the educational video game category?
    a. Art Academy
    b. Frequency
    c. Minecraft
    d. Reader Rabbit

20. Designed by Institute of Play, this New York-based middle school and high school launched in 2009 and bases its curriculum on game theory and game mechanics:
    a. House of Pi
    b. Minecraft Technical Institute
    c. Outerra
    d. Quest to Learn

True or False

21. *Königsspiel* and *Kriegsspiel* were war games designed by Douglas Aircraft Company's RAND Corporation in the 1950s.

22. *F.A.T.S (FireArms Training Simulator)* and the *EST (Engagement Skills Trainer)* are examples of Tactical Engagement Simulation (TES) training systems.

23. An example of a *TLCTS* is *Tactical Iraqi* by Alelo Inc., which brought scenario-based PC gameplay to the Marines before their Surge deployment to Iraq in 2007.

24. Today both medical schools and teaching hospitals are using medical simulation in facilities known as Clinical Skills and Simulations Centers (CSSCs).

25. Dr. Mark Appelbaum of the American Psychological Association concluded that data from over 300 studies between 2005 and 2013 showed no consistent relationship between playing violent video games and an increase in aggressive behavior.

■ FIGURES

Title page image: "Marksmanship simulator trains soldiers without spending ammunition." By Airman 1st Class R. Alex Durbin | 633rd Air Base Wing Public Affairs. March 25, 2013. Retrieved from http://www.jble.af.mil/News/Features/Display/Article/260507/marksmanship-simulator-trains-soldiers-without-spending-ammunition. Image 2: "EA Sports Active More Workouts video game review: EA's new fitness game builds on the solid foundations of its predecessor to offer a more well-rounded home exercise experience." By Nick Cowen for *The Telegraph*. December 2, 2009. Retrieved from http://www.telegraph.co.uk/technology/video-games/6702486/EA-Sports-Active-More-Workouts-video-game-review.html. Image 3: "Strategix Bus Simulator." By Strategix, 2014. Retrieved from http://www.strategix.com.au/news/strategix-bus-simulator.php.

FIGURE 13.1 The simulation spectrum. ("Military Simulations range from field exercises through computer simulations to analytical models; the realism of live manoeuvres is countered by the economy of abstract simulations." By Ordoon - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=3401402. Retrieved from https://en.wikipedia.org/wiki/Military_simulation#/media/File:MilSim_Spectrum.svg)

FIGURE 13.2 Firearms training simulator (a) and engagement skills trainer (b). ("FATS: English: 8th SFS hosts Korean National Police." August 10, 2012. From The Official Web Site of Kunsan Air Base (direct link). United States Air Force Senior Airman Jessica Hines. - Media Gallery, page 1, The Official Web Site of Kunsan Air Base (direct link). Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=23854217. Retrieved from https://commons.wikimedia.org/wiki/File:Airmen_from_the_8th_Security_Forces_Squadron_complete_a_training_scenario_using_a_firearms_training_simulator_on_Kunsan_Air_Base.JPG. "Engagement Skills Trainer." Public domain. Available at https://en.wikipedia.org/w/index.php?curid=19243134. Retrieved from https://en.wikipedia.org/wiki/Engagement_Skills_Trainer#/media/File:Engagement_skills_trainer.jpg)

FIGURE 13.3 Screenshot of (a) *Bradley Trainer* (1980) and (b) an M2 Bradley Fighting Vehicle. ("A standard enemy tank in the player's sights in the military training version The Bradley Trainer."

By US Army - http://www.atariage.com/news/Bradley/, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=29061823. Retrieved from https://en.wikipedia.org/wiki/Battlezone_(1980_video_game)#/media/File:Bradley_Trainer_screenshot.png. "An M2A2 Bradley Fighting Vehicle kicks up plumes of dust as it leaves Forward Operating Base MacKenzie in Iraq for a mission on Oct. 30, 2004." By Shane A. Cuomo, U.S. Air Force - http://www.defenselink.mil/photos/newsphoto.aspx?newsphotoid=5657. Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=224. Retrieved from https://en.wikipedia.org/wiki/M2_Bradley#/media/File:M2a3-bradley07.jpg4980)

FIGURE 13.4 A close-up look at the (a) *MACS* rifle and generically labeled (b) *MACS* cartridge. (MACS rifle image from Amazon.com, Retrieved from https://www.amazon.com/gp/product/B00UYCF2W0/ref=as_li_qf_sp_asin_il_tl?ie=UTF8&camp=1789&creative=9325&creativeASIN=B00UYCF2W0&linkCode=as2&tag=austretrgame-20&linkId=STDYSVM2MXFM7XWF. Cartridge image posted by GAMESOGRE on October 7, 2010 in "Rare Game Showcase: Atari Jaguar Developer's Cart, 3 SNES M.A.C.S., and a Mario Pipe Phone". Retrieved from http://www.videogamemuseum.com/2010/10/07/rare-game-showcase-atari-jaguar-developers-cart-3-snes-m-a-c-s-and-a-mario-pipe-phone/)

FIGURE 13.5 Screenshots from *Marine Doom* (1996) by Wardyga.

FIGURE 13.6 Screenshots from the original *America's Army* (2002) by Wardyga.

FIGURE 13.7 Screenshots from *Full Spectrum Warrior* (2004) by Wardyga.

FIGURE 13.8 Screenshots of *DARWARS Ambush!* (2004). ("DARWARS Ambush." By soldiersmediacenter - Flickr, CC BY 2.0. Available at https://commons.wikimedia.org/w/index.php?curid=3729705. Retrieved from https://en.wikipedia.org/wiki/DARWARS#/media/File:ArmyDARWARS.jpg)

FIGURE 13.9 Screenshots of *Tactical Iraqi* (2007) by Wardyga.

FIGURE 13.10 Players using (a) *VIRTSIM* and (b) BISim Co-CEO Pete Morrison on *VBS Blue*. ("VIRTSIM is the Virtual Reality Platform That Gamers Crave but Can't Have." By Ben Lang - Nov 4, 2012. Retrieved from http://www.roadtovr.com/virtsim-virtual-reality-platform/. Photograph VBS3 © 2007-2017 Bohemia Interactive Simulations, k.s. All rights reserved.)

FIGURE 13.11 Screenshots of the *The Surgeon* (a) and *Life & Death* (b) by Wardyga.

FIGURE 13.12 Types of simulation used in medical education (AAMC, 2011, p. 28). ("Medical Simulation in Medical Education: Results of an AAMC Survey." By Association of American Medical Colleges, September 2011. Retrieved from https://www.aamc.org/download/259760/data)

FIGURE 13.13 *Ultrasound Simulator*. (Screenshot from promotional video, "SonoSim transforms medical education by placing virtual ultrasound devices, patients, and teachers into lab coat pockets." By SonoSim, Inc. April 18, 2013. Retrieved from http://www.prnewswire.com/news-releases/sonosim-transforms-medical-education-by-placing-virtual-ultrasound-devices-patients-and-teachers-into-lab-coat-pockets-203540851.html)

FIGURE 13.14 Screenshots of the *ESP Game* (a) and *Foldit* (b) by Wardyga.

FIGURE 13.15 Dr. Gazzaley with Ann Stewart (67) (a) playing *NeuroRacer* and screenshot (b). ("Dr. Adam Gazzaley looks on as Ann Stewart plays his NeuroRacer game." from "Can brain games keep aging minds young? There's an app for that, says scientists." By Cynthia McFadden, Jake Whitman, and Tracy Connor for NBC News. February 17, 2016. Retrieved from http://www.today.com/health/can-brain-games-keep-aging-minds-young-there-s-app-t73811)

FIGURE 13.16 Strategix bus simulator for pre-employment driving assessment (a) and CAE full-flight simulator of an Airbus A320 cockpit (b). ((a) "Strategix Bus Simulator." By Strategix, 2014. Retrieved from http://www.strategix.com.au/news/strategix-bus-simulator.php. (b) "CAE Expands Its Training Footprint in Asia Pacific." By Nigel Moll. February 13, 2012. Retrieved from http://www.ainonline.com/aviation-news/singapore-air-show/2012-02-13/cae-expands-its-training-footprint-asia-pacific)

FIGURE 13.17 Notable educational titles on the Nintendo DS: (a) *Art Academy,* (b) *Big Brain Academy,* (c) *Brain Age²: More Training in Minutes a Day*, and (d) *My Word Coach.* (*Art Academy* courtesy of Headstrong Games/Nintendo, 2010; *Big Brain Academy* courtesy of Nintendo, 2006; Brain Age2: *More Training in Minutes a Day* courtesy of Nintendo, 2007; and *My Word Coach* courtesy of Ubisoft, 2007.)

FIGURE 13.18 Percentage of digital game use by grade. (From Fishman, B., Riconscente, M., Snider, R., Tsai, T., & Plass, J., 2014. Empowering Educators: Supporting Student Progress in the Classroom with Digital Games (Part 1: A National Survey Examining Teachers' Digital Game Use and Formative Assessment Practices). Ann Arbor: University of Michigan. http://gamesandlearning.umich.edu/agames)

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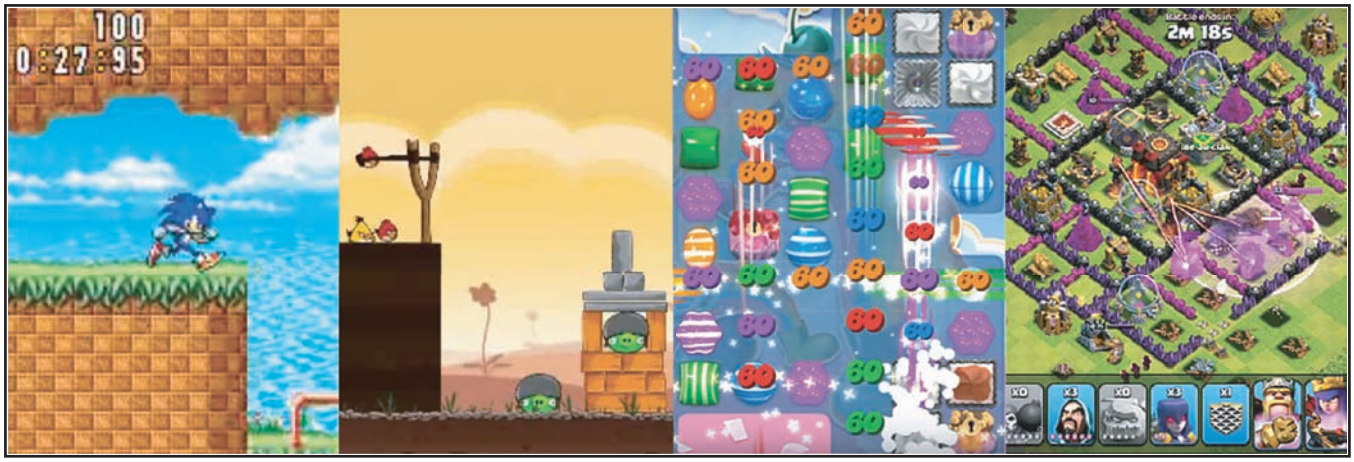
Mobile and Casual Change the Game



OBJECTIVES

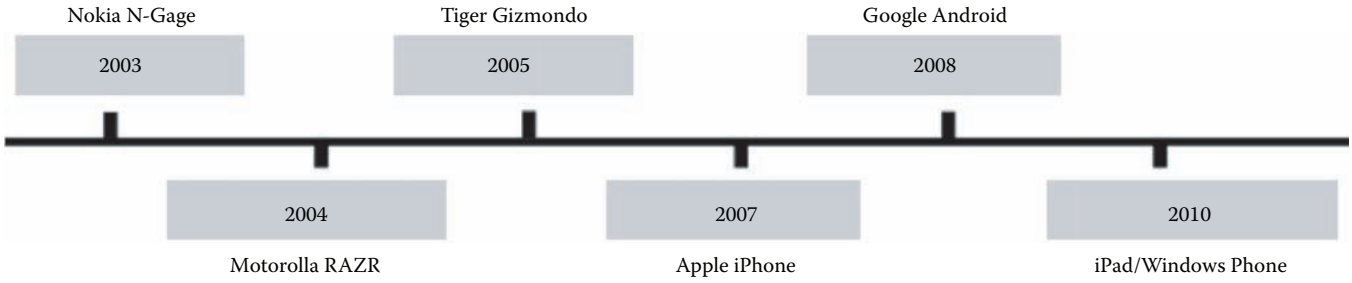
After reading this chapter, you should be able to:

- Provide an overview of early smart devices released in the 1980s and 1990s.
- Review the early days of mobile and casual games, from *Snake* to modern games.
- Recognize the contributions and failures of devices like N-Gage and Gizmondo.
- Explain how Apple revolutionized the mobile gaming business.
- Discuss how touchscreens and accelerometers influenced casual games.
- Be familiar with key breakthroughs and milestones in mobile technology.
- Have a sense of the graphics and capabilities of mobile games as they evolved.
- Recognize how mobile gaming is different from PC and home console gaming.
- List some key casual game titles and genres made popular on mobile devices.
- Describe the influence of casual and mobile gaming on the video game market.
- Be familiar with key mergers and acquisitions of large mobile game companies.
- Discuss how mobile games make money through advertisements and freemium.
- Summarize key mobile/casual gaming market trends and financial developments.

■ KEY TERMS AND PEOPLE

3G
4G LTE
4K resolution
Accelerometer
Activision Blizzard
Ancillary products
Android
Android Market
App Store
Apple
Apple A5
Taneli Armanto
ASA
AT&T
Augmented reality (AR)
Sam Barlow
Big Fish Games
BlackBerry/850
Bluetooth
BREW
Casual game
Terry Cavanagh
Scott Cawthon
Convergence
Dell Streak
Digital Bridges
Digital Chocolate
EA Mobile
EEDAR
Endless runner
Stefan Eriksson
eSports
Feature phone
Firemint
Flurry Analytics
Fragmentation
Freemium
Carl Freer
Game Dev. Choice Awards
Gameloft
Gamevil
Gartner
Giant Interactive
Gizmondo
Glu Mobile
Google Play
GPRS
GSM
Hagenuk Corp.
HandCircus
IBM Simon
Ideaworks3D
Fredrik Idestam
i-mode
Iomo
iOS
iPad
iPhone
iPod Touch
Satoru Iwata
J2ME
Jackbox Games
JAMDAT Mobile
Steve Jobs
King
Mascot Capsule
Match three game
Joel McDonald
Barry Meade
MMS
Mobile game
Mobile VR
MOGA
Moppin
Motorola RAZR
MultiMediaCard
Multi-touch
N-Gage platform
N-Gage QD
Shane Neville
Nintendo
Nokia Corp.
Nokia N-Gage
NTT DoCoMo
Nvidia GoForce
Organiser
Palm/PalmPilot
PDA
pdQ smartphone
Playdead
PlayLink
Playtika
PopCap
Psion
Quad HD
Qualcomm
RedLynx
Rovio Ent.
Samsung
Samsung Galaxy Tab
Samsung Gear VR
Eric Schmidt
Sidetalking
Simogo
Smartphone
Social gaming
Sony Ericsson
Steam app
Supercell
SuperData
Supermassive
Symbian/OS 6.1
Tencent
THQ Wireless
Tiger Telematics
Touchscreen
Unity Tech.
Unwired Planet
WAP
Windows 10 Mobile
Windows Phone
Windows Phone Store
Xperia Z5 Premium
Zynga

■ MOBILE PLATFORMS TIMELINE



■ INTRODUCTION

This chapter reviews the history and technological developments of mobile and casual gaming, which have played a major role in shaping the video game market of today. Coverage includes the companies that have fostered these platforms of gaming and the major breakthroughs throughout the evolution of mobile games from the late 1990s to today. Key people will also be discussed, as well as the popular mobile and casual titles that have helped shape today's video game landscape.

■ MOBILE AND CASUAL GAMES DEFINED

A **mobile game** is a video game that is typically played on an older **feature phone** (multi-function cell phone), **smartphone**, or tablet—however, such games can also be played on a number of **personal digital assistants (PDAs)**, graphing calculators, smartwatches, and other portable media players. Video games are not necessarily the primary function of most mobile gaming devices, which is a key characteristic that separates this platform from dedicated "handheld systems" like the Nintendo 3DS and PlayStation Vita.

Another feature that separates popular mobile games from traditional handheld games is gameplay. Since most smartphones and tablets do not have dedicated action buttons, d-pads, or analog sticks built into them, gameplay is usually limited to the use of the device's **touchscreen** (control by one or more fingers) and/or **accelerometer** (motion sensor that detects titling). While limiting in some ways, such controls are also unique compared to conventional PC and console games, leading to new and innovative gaming experiences that have facilitated a market boom of **casual games**.

While too broad of a term for a single definition, casual games typically: (1) can be designed around virtually any theme, (2) are easy to learn, with relatively few rules, (3) involve simple gameplay (often requiring just one finger), (4) can be played in short bursts of time, and (5) are targeted toward a wide audience, from children to adults. Casual video games have been around since the dawn of gaming but were gradually overshadowed as the industry matured and games became more complex or "hardcore." Extra buttons and longer adventures became routine with each new generation.

This trend was reversed in part by former Nintendo president **Satoru Iwata**, who is often credited for leading the casual games revival with Nintendo's DS touchscreen and Wii's motion control games (Takenaka, 2008). Mobile games have since cemented the casual genre as a staple of modern gaming and its mass appeal has attracted a whole new audience of gamers—many of whom do not even consider themselves gamers at all.

■ PHONES GET SMART

Smartphones evolved from PDAs by utilizing their computer-like, multimedia functionality. The first PDAs were the **Organiser** series released by the British company **Psion** in the mid-1980s. A breakthrough for its time, the Organiser was unfortunately never released outside of Europe.

The **IBM Simon** (1994) (Figure 14.1a) is considered the first smartphone (Connelly, 2014, p. 1). The Simon featured a monochrome touchscreen display, address book, appointment scheduler, calculator, calendar, notepad, and world time clock. Priced at $899, most consumers requiring this type of technology elected to purchase a PDA instead. PDAs gained popularity in the late 1990s with offerings from companies like **Palm, Inc.** (U.S.). The **PalmPilot** (Figure 14.1b) debuted on March 10, 1997 and was the first PDA to be successfully marketed across the globe.

Canada's **BlackBerry** became an early leader of smartphones, with the BlackBerry OS debuting in January 1999 on the **BlackBerry 850** pager (Figure 14.1c). **Qualcomm**'s **pdQ smartphone** released that June, which was the first "smartphone to offer the Palm Computing platform and support full-time access to the Internet based upon standard Internet protocols" (Qualcomm, 1999, para. 1).

Palm and BlackBerry were early leaders in mobile technology and the most common operating system for smartphones during that time was Psion's **Symbian**. As the century came to a close, mass adoption of the first smartphones was first achieved in Japan thanks to backing from the country's three major telecom companies "**NTT DoCoMo**, KDDI and Softbank (formerly Vodafone Japan)" (Budmar, 2012, para. 3). While PDAs and smart/feature phones were praised for their

FIGURE 14.1 "Smart" devices: (a) IBM Simon, (b) PalmPilot with stylus, and (c) BlackBerry 850 pager.

(a) (b) (c)

multimedia capabilities, most of these devices in the 1990s lacked a reasonable selection of games.

■ MOBILE GAMING ORIGINS

A major reason for the success of mobile and casual gaming was accessibility, as more and more consumers adopted feature phones which included the ability to play video games. The first game to appear on a mobile phone was a preinstalled version of *Tetris* on the Hagenuk MT-2000 cell phone by Danish manufacturer **Hagenuk Corporation** in 1994 (Microsoft Devices Team, 2013, para. 3). Three years would pass before the mainstream mobile market would receive its first big hit with *Snake* in 1997 (Figure 14.2).

Programmed by Finnish developer **Taneli Armanto** for the Nokia 6110, *Snake* was based off of the 1976 arcade game *Blockade* by Gremlin. The object of the one-player game is to navigate a perpetually moving snake toward a dot (food) which increases the length of the snake. The goal is to grow as long as possible and the game ends when the snake crashes into a wall or itself when the snake is long enough. *Snake* was also the first multiplayer mobile game, where two people could play together via infrared ports on their Nokia phones.

DID YOU KNOW?

Since the debut of *Snake* in 1997, "it has been estimated that over 400 million copies have been shipped since and it's now in its eighth version" (Wright, 2016A, para. 4).

FIGURE 14.2 Snapshot of *Snake* (1997).

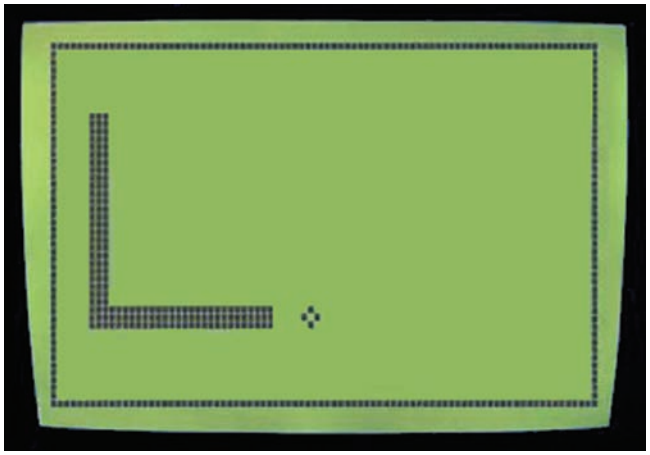


TABLE 14.1 Notable Early WAPGames from 2000–2001

Game	Developer	Country
Alien Fish Exchange	nGame	United Kingdom
DataClash	nGame	United Kingdom
Gladiator	JAMDAT Mobile	United States
Lifestylers	Picofun	Sweden
Picofun Football	Picofun	Sweden
Sorcery	Digital Bridges	United Kingdom
The Lord of the Rings	Riot-E	Finland
Void Raider	Unplugged Games	United States
WAP Tanks	Handy Games	Germany
Wireless Pets	The Games Kitchen	United Kingdom

Aside from *Snake* in 1997, mobile games weren't a major platform until the early 2000s when feature phones became more sophisticated and began offering greater multimedia functions. Games remained primitive during this time, using **Wireless Application Protocol (WAP)** as the standard technology for connecting to the Internet. One of the pioneers of WAP was **Unwired Planet** who developed a microbrowser for mobile phones—yet WAP was most commonly used for accessing email or text-based newsfeeds. It was most successful in Europe due to standardization across companies and was also popular in Japan, although market leader NTT DoCoMo used its own online system called **i-mode** (Wright, 2016A, para. 8). Adoption of WAP in the United States was slow, however, since each cell phone provider had its own data support and fee structures.

■ THE NEW MILLENNIUM OF MOBILE

Subscription-based gaming began in Japan through NTT DoCoMo's i-mode in 1999. Soon an infrastructure was developed for WAP users to purchase mobile games over the network. With the technology advancing, what the mobile industry needed were some innovative software companies to push the envelope with quality game titles. One of the first key publishers formed around this time was **JAMDAT Mobile**, founded by Activision game execs Scott Lahman, Zachary Norman, and Austin Murray. The other key company was French developer/publisher **Gameloft**, formed by a joint venture between Guillemot Corporation and Ubisoft (Wright, 2016B, para. 4 & 7). Other notable early mobile developers included **Digital Bridges** (U.K.), Hands-On Mobile (U.S.), Handy Games (Germany), IOMO (U.K.), Picofun (Sweden), and Riot-E (Finland). See Table 14.1 for key early WAP titles from these and other companies.

The early 2000s was a pivotal time for mobile gaming. Simple monochrome, dot matrix displays and single-channel tones would soon be replaced by color screens with higher resolution graphics and multichannel sound. Games became faster and more sophisticated with new mobile programming languages such as **Java 2 Micro Edition (J2ME)** and Qualcomm's **Binary Runtime Environment for Wireless (BREW)**. "J2ME proved to be a massive success in Europe, while BREW was more popular in North and South America and Asia" (Phone Arena, 2011, para. 4). Sega and Sonic Team produced an impressive port of *Sonic the Hedgehog* on i-mode in Japan, and in 2003 the game would be released in other countries on a new platform by Nokia.

■ NOKIA N-GAGE

Nokia Corporation is a Finnish company founded in 1865 by **Fredrik Idestam** as a wood pulp mill for manufacturing paper. The company expanded in the early 1900s to manufacturing cables and electronics, and eventually gas masks for the Finnish Defence Forces (Hahn, 2013, para. 2 & 8). After acquiring many telecommunications companies in the late 1980s, Nokia went on to become the world's largest mobile phone manufacturer in 1998 (Nokia, 1998, para. 2). The company has also played a major role in the development of wireless communication standards including **Global System for Mobile Communications** (**GSM**), **3G (third generation)**, and **Long-Term Evolution (LTE)**.

With its strong reputation in the mobile phone industry, Nokia announced in 2002 that it was working on a PDA that was both a phone and video game system,

FIGURE 14.3 Nokia N-Gage handheld game console and mobile phone.

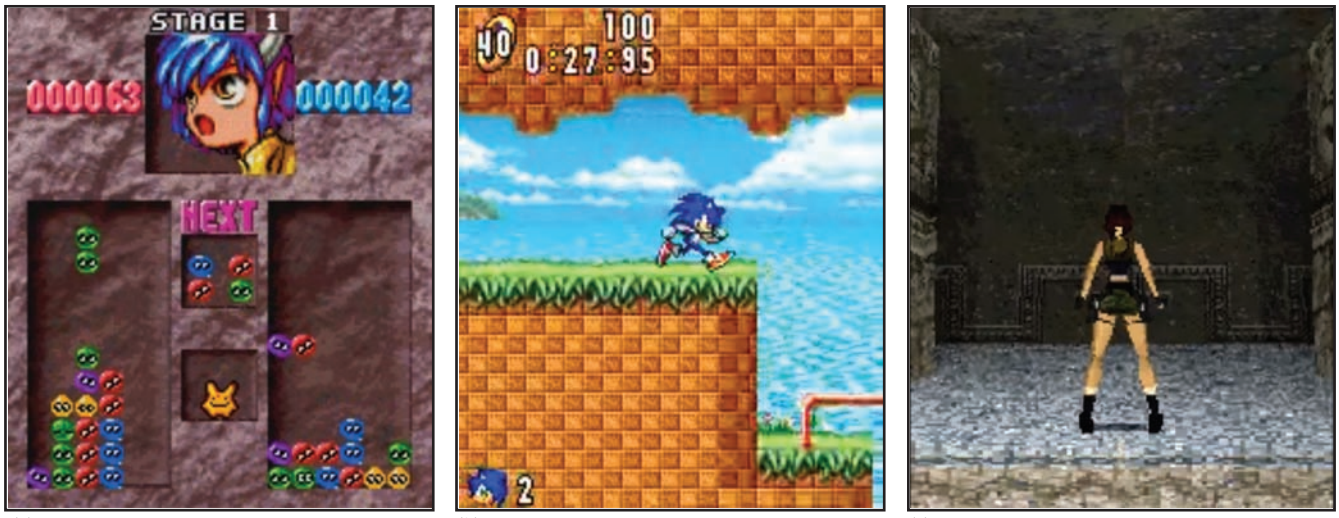
among other things. Codenamed "Starship," the completed device was officially titled "N-Gage" (Figure 14.3) and released on October 7, 2003 for $299. See Table 14.2 for launch titles. The unit ran on the then-popular **Symbian OS 6.1** (Series 60) operating system and used **General Packet Radio Service (GPRS)** for data transmission. "GRPS is considered a '2.5G' technology, meaning it is more advanced than standard 2G digital technology, but does not meet the requirements of a full-fledged 3G technology" (Phone Scoop, 2001, para. 8).

TABLE 14.2 Nokia N-Gage Launch Titles

- Pandemonium
- Puyo Pop (Figure 14.4a)
- Puzzle Bobble VS
- SonicN (Figure 14.4b)
- Super Monkey Ball
- Tomb Raider: Starring Laura Croft (Figure 14.4c)

In addition to its access to WAP over GPRS, N-Gage featured full email support, an XHTML browser, **Bluetooth** connectivity for wireless multiplayer gaming, and a USB port for downloading data from a PC. For sound, the original model tripled as an MP3 music player, digital audio recorder, and an FM radio. Along with video playback and PDA features, Nokia bundled the system with just about everything except a digital camera. Of course, the N-Gage was built to be a powerful mobile video game system and could handle complex 3D games that looked similar in quality to PS1 titles. Games were controlled with the directional pad on the left of the controller and the main action buttons consisted of numbers five (5) and seven (7) on its numerical keypad. Games came in the form of **MultiMediaCards (MMCs)** which looked just like SD cards. The game card slot however was inconveniently located inside its battery compartment.

FIGURE 14.4 Screenshots of N-Gage launch titles (a) *Puyo Pop*, (b) *SonicN*, and (c) *Tomb Raider: Starring Laura Croft*.



(a) (b) (c)

FIGURE 14.5 Screenshots from one of the banned Nokia commercials from 2003.

The original N-Gage was bundled with a cell phone battery and charger, hands-free headset, USB cable, 3.5 mm adapter cables, music transfer software, and a 141-page user's guide. There was no memory card or physical pack-in game included. Speaking of games, the packaging for N-Gage games was quite unique. The small plastic cases are horizontally oriented and "included a mini game card case in which players can transport up to four games in. The plastic case is smaller in length and width than a standard business card, and is roughly a quarter of an inch thick" (IGN Staff, 2003, para. 6–7).

Nokia's target market for N-Gage was consumers between the ages of 18 and 35 and the slogan for the device was "N-Gage – Anyone Anywhere." While most of its advertising for the system was relatively standard for the time, one print and television campaign ended up being banned by the **Advertising Standards Authority (ASA)** in the U.K. The ads featured desolate environments with messages such as "This is where I made Kev look small" and "This is where I left Kate, Lucy and Michelle begging for more" (shown in Figure 14.5). Nokia claimed, "the ads were just promoting the wireless-gaming aspect of the phone … by showing unique environments where users wouldn't expect to play their games and highlighting the competitive nature of gaming" (Best, 2004, para. 3).

TABLE 14.3 Nokia N-Gage Tech Specs

Manufacturer:	Nokia|October 7, 2003
Format:	MultiMedia Card/850 mAh lithium-ion battery (3–4 hours)
Processor:	32-bit ARM920T CPU (104 MHz)
Memory:	3.4 MB internal storage (up to 64 MB with memory card)
Resolution:	176 × 208 pixels (2.1" backlit display)
Colors:	4096
Sound:	Built-in speaker with 2.5 mm stereo jack and Bluetooth 1.1

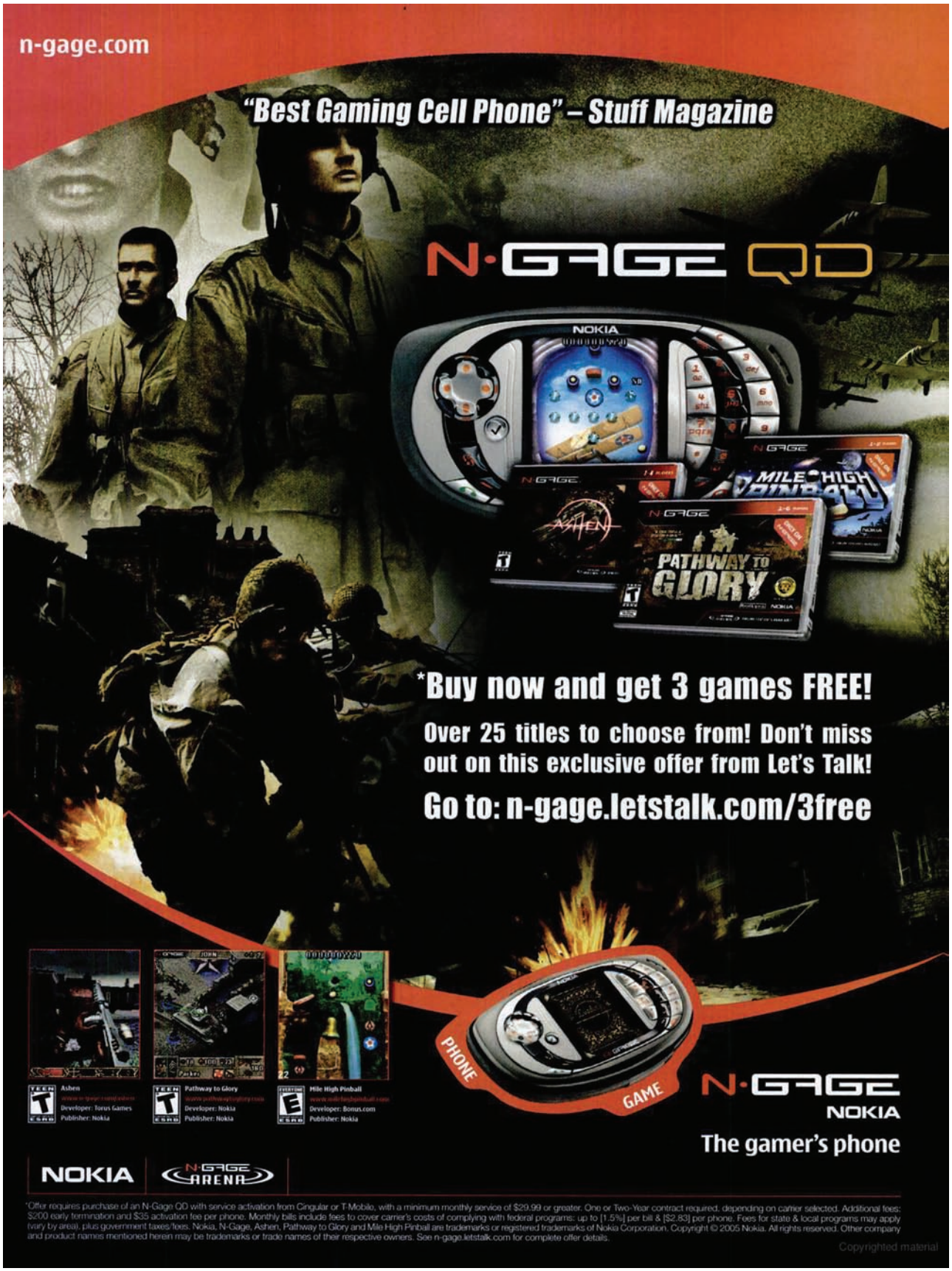
■ THE COMPETITION

The N-Gage's biggest competition at the time of its release was Nintendo's Game Boy Advance, which could be purchased for a third of the price at around $99 in 2003. Despite its more powerful processor (Table 14.3), N-Gage paled in comparison to the GBA's popularity, which eventually reached more than 81 million units sold. The real adversity came just over a year after reaching the market, when the fate of N-Gage was sealed with the release of even more powerful handhelds by Nintendo and Sony with the Nintendo DS and PlayStation Portable.

The N-Gage also faced competition among mobile phones like the slim and stylish **Motorola RAZR** released during the third quarter of 2004. "Some classic RAZR games include *Spyro – Ripto Quest, Space Invaders*, and *Grid Runner++*" (Purewal, 2011, para. 8). The RAZR was a huge success primarily due to its much-lauded, ultra-slim design, selling "over 50 million units by July 2006 and Motorola's top-shelf brand pushed 130 million units in four years" (Hachman, 2012, para. 3).

Perhaps the N-Gage's greatest competitor was itself. Along with some missteps in its advertising, the original

FIGURE 14.6 Print advertisement for the N-Gage QD in 2005.



system's high price, lack of original games, and design flaws (such as the cramped action buttons on the key pad and having to power off the system and remove the battery to change games) led to early criticism of the system among gamers and journalists (Snow, 2007, para. 2).

One of the more unusual criticisms of the N-Gage was how it became infamously known for its "taco-like" shape. The speaker and microphone were located on the upper, flat side of the phone and it just looked plain silly when users held it up to their head to communicate with a caller—almost like a giant ear. This led to the Internet meme known as "**sidetalking**" (Giant Bomb, 2017, para. 2).

Nokia introduced a redesigned **N-Gage QD** (Figure 14.6) in May 2004, which improved upon many of the first model's shortcomings but removed features like MP3 playback, FM radio reception, and USB connectivity to reduce costs. Sales remained slow and all N-Gage hardware was discontinued in November 2005. Prior to its discontinuation, Nokia explained at their E3 presentation that the N-Gage name would survive as a gaming service platform that would be accessible to a variety of qualifying phone models.

The **N-Gage platform** (also called "N-Gage 2.0") was released to the public on April 3, 2008 through the N-Gage official website but was compatible with only five Nokia phones. With only 49 games released on the online platform, Nokia ceased production of new titles on October 30, 2009 and all N-Gage services were terminated at the end of 2010 (Duncan, 2009, para. 2).

DID YOU KNOW?

Market analysts from Arcadia Research estimated that Nokia's U.S. launch for N-Gage "sold under 5000 units across both videogame and mobile phone retailers," placing it among the weakest console releases of all time (Fahey, 2003, para. 1 & 3).

■ KEY N-GAGE TITLES

Only around 58 titles were released for N-Gage. Its early lineup featured many games that, while impressive to see on the small screen of a phone, were older titles that had been available on home consoles for years. Games from the PS1 era included *Tony Hawk's Pro Skater, Tomb Raider*, and *Pandemonium*, while games like *Puyo Pop, Puzzle Bobble*, and *Sonic* dated back to the 16-bit era. Stronger titles began to appear in 2004 including the turn-based strategy game *Pathway to Glory* by **RedLynx** and *The Sims Bustin' Out* (**Ideaworks3D**/EA Games) (shown in Figure 14.7). Other hits from 2004 included *Colin McRae Rally 2005* (Ideaworks3D), Sega's *Pocket Kingdom: Own the World, Tom Clancy's Ghost Recon: Jungle Storm* by Gameloft, a few soccer titles, and *Tiger Woods PGA Tour 2004* from Backbone Emeryville and EA Sports.

The year 2005 was the system's strongest, albeit last year for software releases. Top games from this year included another exclusive turn-based strategy game by RedLynx called *High Seize*, as well as two excellent 3D racing games with *Glimmerati* (Bugbear) and *System Rush* (Ideaworks3D). One of the best games of the year was **Iomo**'s free download of *Snakes*, which was a 3D reimagining of the classic *Snake*. Other notable titles from 2005 were *Mile High Pinball* by Bonus Mobile Entertainment, *Tom Clancy's Splinter Cell: Chaos Theory* by Gameloft, *Worms World Party* from Paragon 5, along with fighting games *King of Fighters Extreme* by Hudson and *ONE* from Digital Legends.

The majority of these and other games released for the N-Gage were intricate titles that provided console-like gaming experiences, requiring time and dedication to play. In an interview with Jonathan Keane (2015), Nokia producer and indie games developer **Shane Neville** explained; "If you look at mobile games now, it was never core gamers that made gaming work on mobile. It's casual

FIGURE 14.7 Five of the best N-Gage titles: (a) *Rayman 3*, (b) *Pathway to Glory*, (c) *The Sims Bustin' Out*, (d) *Glimmerati*, and (e) *Tom Clancy's Splinter Cell: Chaos Theory*.

(a) (b) (c) (d) (e)

FIGURE 14.8 Early mid-2000s mobile hits: (a) *Prince of Persia: The Sands of Time* (Gameloft), (b) *The Fast and the Furious,* (Digital Bridges), and (c) *Tower Bloxx* (Sumea/Digital Chocolate).

(a) (b) (c)

gamers. Nokia wasn't going for that audience at all," he says. "I think that's the opportunity that Nokia missed (para. 13). In the end, Nokia's N-Gage served as a prime example of a game system that was ahead of its time in many regards, but completely missed the mark in others."

■ OTHER MOBILE DEVELOPMENTS

In addition to N-Gage, color displays on other mobile phones became more affordable in 2003 and casual puzzle games like **PopCap**'s *Bejeweled* reached millions of users as a popular game bundled on many phones. In May of that year, Electronic Arts and 3DO founder **Trip Hawkins** "invested $405,000 of his own cash to buy back some of the company's patents and brands and set about launching **Digital Chocolate**," a mobile game publisher whose titles "would be based on original ideas, not expensive brands licensed from other media" (Wright, 2008D, para. 6). Notable mobile titles from this period included *Space Invaders* (Distinctive Developments) and *Siberian Strike* (Gameloft), followed by *Ridge Racer 3D* (Namco) and *Nom* (**Gamevil**).

The year 2004 marked the year that large publishers like **EA Mobile** and JAMDAT Mobile dominated the cellular market and ports of popular console games became more commonplace. Popular mobile games at this time included Gameloft titles *Asphalt Urban GT, Might and Magic, and Prince of Persia: The Sands of Time* (in Figure 14.8), plus sports titles *Tony Hawk's Pro Skater* (Ideaworks3D), *MotoGP 2* (**THQ Wireless**), and *JAMDAT Bowling.* JAMDAT would have further success with *Neverwinter Nights* and *Bejeweled Multiplayer, while* Sony Online Entertainment developed the mobile RPG *EverQuest: Hero's Call* (Harz, 2004, para. 7). *Duke Nukem Mobile* (MachineWorks Northwest) "was a scrolling shooter designed for the Motorola T720, the LG VX4400, the LG VX4500, the LG VX6000, and the Samsung SCH-A530. The title proved to be popular enough that *Duke Nukem Mobile II: Bikini Project* was released a year later" (Purewal, 2011, para. 10).

■ GIZMONDO

The same year that software development ceased for the Nokia N-Gage, Europe's **Tiger Telematics** launched **Gizmondo** (Figure 14.9) in the U.K. on March 19, 2005 for £229. The device was later released in the United States and mainland Europe. While it wasn't a mobile phone, "it did have a slot for a SIM card and supported the likes of WAP, GPRS and SMS/MMS, so despite not having a number pad or voice capacity, it was near enough" (Wright, 2008, para. 3).

Gizmondo was a technically superior game machine to N-Gage with a 400 MHz Samsung ARM9 processor, **Nvidia GoForce** 3D 4500 GPU, and 320 × 240 resolution.

FIGURE 14.9 Gizmondo (2005).

However, critics panned the system with its $400 price tag and limited game library. Soon after its release, company execs including Tiger CEO **Carl Freer** and Director of Gizmondo Europe **Stefan Eriksson** were linked to criminal activity with Sweden's Uppsala Mafia. Records showed that Tiger "lost more than $300 million between January 2004 and July 2005" (Sullivan, 2006, para. 25 & 39) and the system was ordered into liquidation. Fewer than 25,000 units were sold and "only eight of the 14 planned games were ever released" in the United States (Snow, 2007B, para. 5).

■ STILL GROWING

Despite commercial failures like N-Gage and Gizmondo, mobile gaming revenue continued to climb during 2005 and in 2006. In June 2005, Sorrent (California) merged with Macrospace (London) to form **Glu Mobile**. Numerous other buyouts and mergers took place around this time, including EA Mobile's purchase of JAMDAT for $680 million in February 2006. The mobile gaming business was expanding, but **fragmentation** in the technology remained an issue.

While Nokia and Motorola supported Java for its devices, **Sony Ericsson** used **Mascot Capsule** for its phones. This fragmentation resulted in most game publishers focusing "on porting games to as many handsets as possible rather than making as many great games as possible" (Wright, 2009, para. 8). Furthermore, with the business structure of mobile games being distributed by the network operators and publisher portals, small developers needed a more effective way of making money on their games.

■ APPLE IPHONE

The mobile world would change dramatically after **Apple** launched its **iPhone** (shown in Figure 14.10) on

FIGURE 14.10 Advertisement for the original Apple iPhone in 2007.

June 29, 2007. Mobile gaming, as well as Apple, would see a tremendous surge in popularity and revenue. The iPhone was built in collaboration with **AT&T** (then Cingular Wireless) for an estimated $150 million (Vogelstein, 2008). Essentially a handheld computer, the iPhone replaced the complex keypads and tiny buttons of older smartphone models with an easy-to-use touchscreen. It also included accelerometer support where games could be programmed to react to tilting the phone in different directions, as well as "a proximity sensor that could automatically turn off the screen when close to the face, and an ambient light sensor that could automatically adjust brightness" (Ritchie, 2017, para. 8).

The original two iPhone models included 4 GB of memory for $499 and an 8 GB model for $599. See Table 14.4 for specs. The first-generation iPhones were quickly followed by the less expensive **iPod Touch** on September 5, 2007. The Touch included most of the iPhone's multimedia functionality such as a Safari browser, digital camera, music and video playback, typical PDA features, and the ability to play video games. The most noticeable difference was that the Touch lacked phone capabilities. It was not a smartphone and could not access cellular network data—however, users were able to connect to the Internet via Wi-Fi.

While it generated plenty of hype, the original iPhone did not take off right away and Apple dropped the price of the 8 GB model by $200 during the release of the Touch. The first model managed to sell more than 6 million units "but it wasn't until 2008—when Apple unveiled the iPhone 3G with a new $200 price tag and access to the faster 3G network—that the smartphone exploded in popularity" with Apple selling more than 10 million iPhone 3G units worldwide in only five months (Chen, 2009, para. 4).

TABLE 14.4 Original iPhone Tech Specs

Manufacturer:	Apple, Inc.|June 29, 2007
Format:	4 GB or 8 GB flash memory Internal battery (3 gaming hours)
Processors:	Samsung 32-bit ARM 1176JZ (F)-S v1.0 CPU (412MHz) PowerVR MBX Lite 3D GPU
Memory:	128 MB eDRAM
Resolution:	320 × 480 pixels (3.5" touchscreen display)
Colors:	262,144
Sound:	Stereo speaker with 3.5 mm stereo jack and Bluetooth capability

By cleverly using the first letters of "Apple" and "application," Apple coined the term "app" for all programs—including games that would run on its **iPhone operating system (iOS)**. Launched during the summer of 2008, the **App Store** digital storefront was a key factor behind the iPhone's success as a gaming platform (Langshaw, 2011, para. 7–8). "Suddenly, here was a platform that enabled consumers to buy games as easily as they had bought MP3s via iTunes. It also enabled developers to sell their games directly to consumers without having to deal with publishers and operators" (Wright, 2009B, para. 11). This opened the door for a wealth of independent developers.

It was relatively easy for developers to upload games to the App Store. "All software developers had to do was code an interesting app, submit it to the App Store for approval and market the app however they wished. Then, Apple gives developers 70 percent of each app sale, keeping 30 percent to cover credit-processing fees" (Chen, 2009, para. 16). End users are provided with the ability to rate their apps in the App Store, helping quality games stand out over weaker titles.

This user- and developer-friendly platform leveled the playing field between the large publishers and smaller developers, helping to facilitate an independent gaming boom that saw its principal audience on mobile devices. Early iOS titles could be purchased from $0.99 to $9.99. Games also used monetization methods like those on PC, where games could be downloaded for free using ad support as a means of revenue, or played via **freemium** with limited free features such as restricted game time or lives.

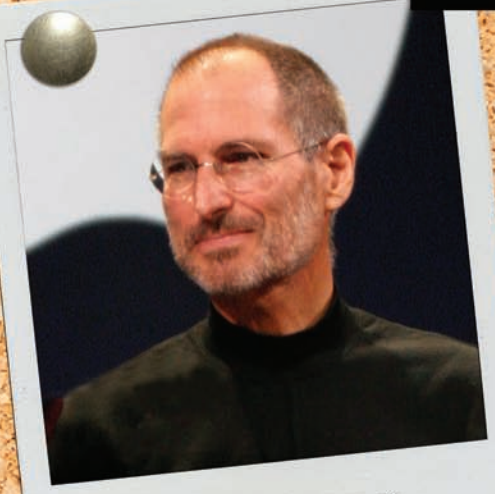
DID YOU KNOW?

The first generation of iPhones did not include **Multimedia Messaging Service (MMS)** support for sending or receiving multimedia messages.

■ EARLY IPHONE GAMES

With no App Store or 3G access in 2007, early iPhone adopters had to wait until 2008 to get their hands on a library of quality video games. Among the most memorable titles from 2008 was *Rolando* by **HandCircus** (Figure 14.11a), released on December 18. At $9.99, *Rolando* was one of the more expensive games but one of

PRO FILE



STEVE JOBS

KEY FACTS:

Co-founder, chairman, and CEO of Apple, Inc.

Pioneered the personal computer and modern smartphone revolution

PRO FILE

HISTORY:

- Born: February 24, 1955, San Francisco, CA
- Died: October 5, 2011, Palo Alto, CA

EDUCATION:

- Homestead High School (1972), Reed College (1 sem.)

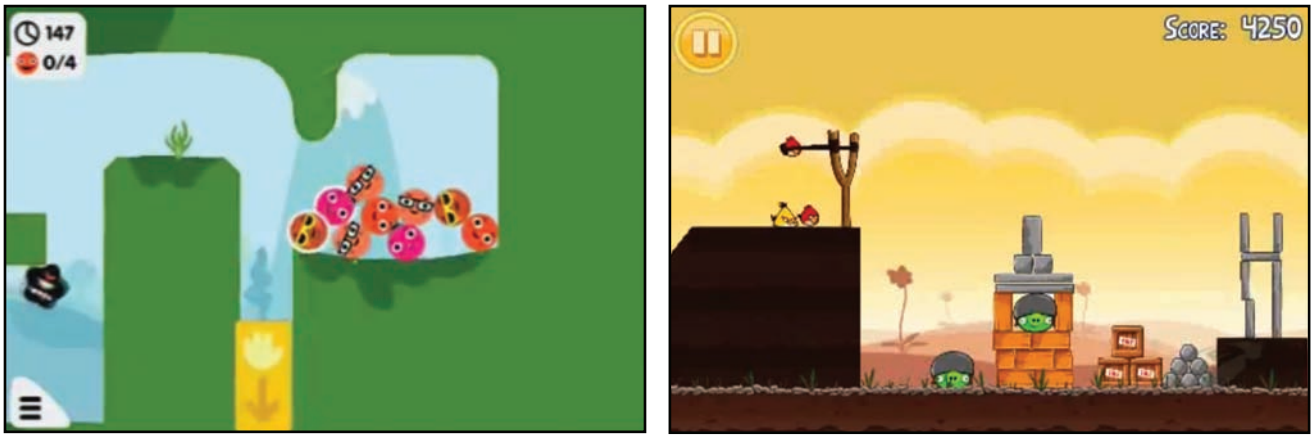
CAREER HIGHLIGHTS:

- Joined Atari in 1973 and assisted Steve Wozniak with the arcade hit Breakout in 1976
- Co-founded Apple Computer Company with Wozniak on April 1, 1976 and founded NeXT Inc. in 1985
- Returned to Apple as CEO in 1997, launching iMac (1998), iTunes and iPod (2001), iPhone (2007), the App Store (2008) and iPad (2010)

RECOGNITION:

- National Medal of Technology (1985), Jefferson Award for Public Service (1987), Entrepreneur of the Decade by Inc. (1989), Howard Vollum Award by Reed College (1991), inducted into the California Hall of Fame (2007), Grammy Trustees Award (2012), etc.

FIGURE 14.11 Screenshots of early iOS games: (a) *Rolando* (2008) and (b) *Angry Birds* (2009).



(a) (b)

the first to utilize the iPhone's accelerometer, as well as its **multi-touch** technology. Multi-touch enabled the touchscreen's surface to sense the presence of more than one finger, providing functionality such as panning the screen. *Rolando's* interactive environments, intuitive controls, and catchy soundtrack made the game a hit for both critics and gamers alike.

While a handful of memorable game titles came out on iPhone during the first two years, it was 2009 when the mobile gaming boom really took off. The year 2009 saw an explosion of highly rated titles including *Rolando 2: Quest for the Golden Orchid* (HandCircus) and *Zen Bound* (Secret Exit), along with best-selling titles *Doodle Jump* (Lima Sky) and *Angry Birds* by **Rovio Entertainment** (Figure 14.11b)—each game breaking 10 million units sold. Other notable titles included *Real Racing* and *Flight Control* by **Firemint** and Gameloft's *N.O.V.A.—Near Orbit Vanguard Alliance*. With the iPhone and App Store's success, it would only be a matter of time before other major companies would follow in Apple's footsteps with platform offerings from Google and Microsoft.

■ MORE PLATFORMS THAN EVER

Before the iPhone, Google acquired **Android, Inc.** in 2005 and was poised to compete with Windows Mobile and BlackBerry-style phones. This all changed after attending the iPhone launch event, when Google's then-CEO, **Eric Schmidt** refocused the company's **Android** technology to compete with the iPhone (Ritchie, 2017, para. 33). Google's Android OS was based on the Linux kernel and the first phone to use the operating system was the **HTC Dream** (also called the T-Mobile G1) on September 23, 2008. The platform was quickly adopted by other manufacturers like **Samsung**, LG, and Motorola, who became leading producers of Android smartphones. Like the App Store, Google launched its own **Android Market** (now **Google Play**) store on October 22, 2008.

DID YOU KNOW?

Similar to how the World Meteorological Organization gives short, distinctive names to hurricanes in alphabetical order, each version Android OS is named alphabetically after desserts and sweets (e.g., Cupcake [v. 1.5], Donut [v. 1.6], and Eclair [v. 2.0]).

Apple's next platform for the mobile gaming market was its **iPad** line of tablet computers released on April 3, 2010. Like the iPhone, the iPad ran on iOS and was bundled with multimedia capabilities. It wasn't a phone, but its larger, 9.7-inch screen size made it easier to play certain games. Android tablets emerged soon after in 2010, with releases such as the **Dell Streak** and **Samsung Galaxy Tab**. Like with smartphones, Android tablets eventually outsold the iPad due to the vast amount of companies manufacturing them and their lower price tag. Microsoft followed with **Windows Phone** in 2010 followed by the **Windows Phone Store**. Amazon became a popular digital distribution platform for Android apps soon after.

These platforms offered "more flexibility than Apple's store since developers could distribute their games via any platform they desired" (Langshaw, 2011, para. 9). Multiple storefronts, smartphone platforms, and tablets made titles easier to obtain, leading to tremendous growth and greater competition. The year 2010 also saw the end of AT&T's exclusivity deal with iPhone. Soon, other service providers (beginning with Verizon) would obtain the rights to carry the phone. The iPhone continued to evolve and "the iPhone 4 was named the fastest-selling portable gaming system by Guinness after selling an estimated 1.5 million handsets on the first day it was released on June 24, 2010" (Los Angeles Times, 2011, para. 3).

While the technology had been in development for many years, 2010 marked the year that 100 mbps **4G LTE** wireless networks started gaining ground, making downloading apps and online gaming faster than ever. Popular multiplatform games that debuted on iOS in 2010 included casual hit *Fruit Ninja* by Halfbrick Studios (Figure 14.12a), *Cut the Rope* (ZeptoLab/Chillingo), *Real Racing 2* (Firemint), and *Plants vs. Zombies* by PopCap (Figure 14.12b), among many more. iOS also remained the exclusive platform for titles such as the graphically intensive *Infinity Blade*, *Helsing's Fire*, and *Space Miner: Space Ore Bust*.

The year 2011 was the year that smartphones finally outsold standard feature phones and the growing popularity of Android led to the platform receiving numerous ports of games that were once exclusive to iOS. Android users even saw a handful of decent exclusive titles of their own. iOS games received a major boost in performance with the release of the 32-bit **Apple A5** chip which "allowed the iPad (and iPhone) to render graphics seven times faster, according to Apple. Titles like *Infinity Blade 2, Real Racing 2* and *The Dark Meadow* showed how the additional power could be used to change the conception of what a mobile game can look like" (Savitz, 2012, para. 4). One major acquisition that year included Electronic Arts buying PopCap Games for $750 million.

Three years after its launch on the Wii and Windows, 2D Boy's *World of Goo* was finally ported to iPhone and Android. Another late but important port was *Words With Friends* by **Zynga**, when it brought its **social gaming** hit to Android. The year 2011 also saw the release of "**endless runner**" (forced progression) games *Jetpack Joyride* (Halfbrick Studios) and *Tiny Wings* (Andreas Illiger). The adventure game *Superbrothers: Sword & Sworcery EP* (Capy Games/Superbrothers) would follow *Cut the Rope* as the **Game Developers Choice Awards** winner for Best Mobile/Handheld Game. On a sadder note, 2011 was also the year that the world said good-bye to Apple's visionary CEO **Steve Jobs**, when he lost his battle with pancreatic cancer on October 5.

■ MOBILE MILESTONES

By 2012, there were more than 500 million mobile gamers across the globe and mobile game revenue surpassed $9 billion with an annual growth rate of 32% (Nouch, 2013, para. 1 & 3). While casual games continued to dominate the medium, a number of hardcore-style games like *Horn* (Phosphor Games Studio, LLC/Zynga) and *The Walking Dead* (Telltale Games) showed that mobile was capable of delivering more console-like experiences. Bluetooth gamepads such as the **MOGA**

FIGURE 14.12 Screens of multiplatform hits (a) *Fruit Ninja* and (b) *Plants vs. Zombies* (2010).

(a)

(b)

FIGURE 14.13 Screenshots of (a) *Clash of Clans* and (b) *Candy Crush Saga* (2012).

(a) (b)

(Mobile Gaming) controller by PowerA began to emerge, allowing compatible mobile games to be played with analog sticks, face buttons, and shoulder triggers.

Top games from 2012 included *Bastion* (Supergiant Games/Warner Bros. Interactive Entertainment), *The Room* (Fireproof Games), *Angry Birds Star Wars* (Rovio Entertainment), *Rayman Jungle Run* (Pasta Games/Ubisoft), and *Super Hexagon* (**Terry Cavanagh**). Two of the highest grossing games included the freemium strategy game *Clash of Clans* by **Supercell** (Figure 14.13a) and **King**'s free-to-play casual puzzler *Candy Crush Saga* (Figure 14.13b). Essentially a touchscreen reimagining of *Bejeweled, Candy Crush Saga* popularized the tile-matching genre on mobile, often referred to as "**match three**" games.

Technology research firm **Gartner** reported that 79% of all smartphones sold between April and June 2013 were running on Android—that's 177.9 million Android handsets compared to 31.9 million iPhones (Dredge, 2013, para. 1). Yet the trend of games being developed for iOS before Android would continue. The main reason for this is that it has been easier to program an app for a small number of iOS platforms that use relatively similar technology. Android, on the other hand, can take longer to develop for due to the vast amount of devices on the market using different versions of the Android OS, at numerous resolutions, with an assortment of processors.

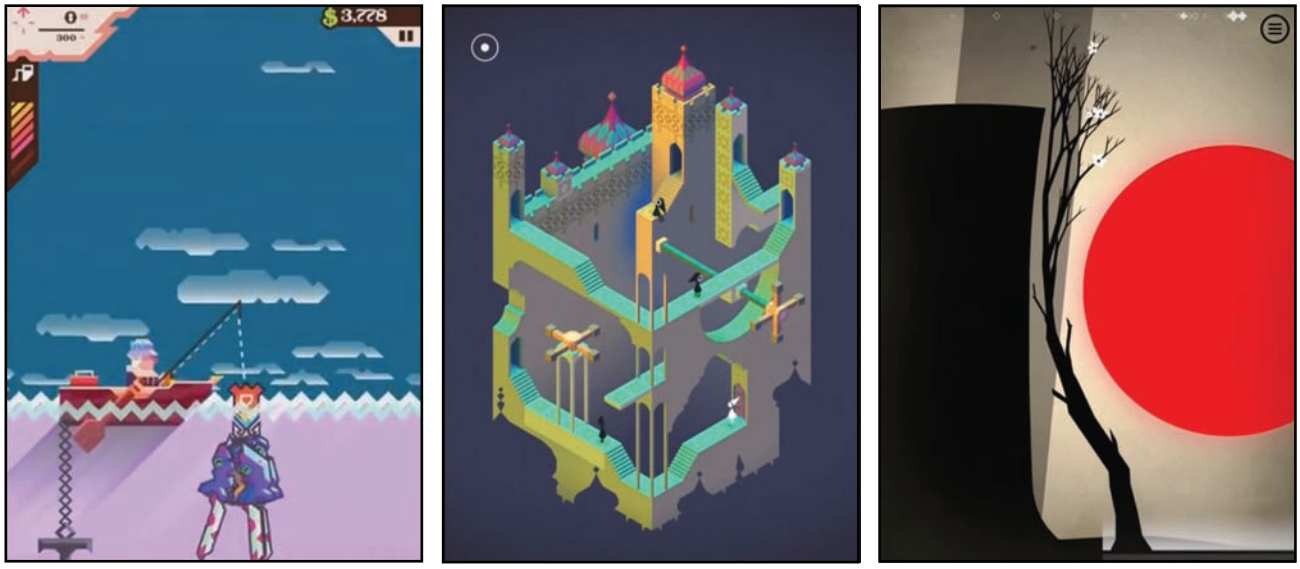
This mobile fragmentation is less of a problem for large developers. Furthermore, "improved development tools are making porting easier, and there's more data (including Google's own) to help developers decide which Android devices to focus their energies on first" (Dredge, 2013, para. 12). Also, by the time games that premiere on iOS are ported to Android, most of the bugs have been worked out. As Fireproof Games developer **Barry Meade** explained; "What Android users forget is that because their versions come later they get the least buggy, higher performance version of the game because iOS users are, in an indirect way, guinea pigs for the other releases" (Kuchera, 2015, para. 10).

As Table 14.5 indicates, mobile ports times are improving. For example, *The Room* (2012) took Fireproof Games 6 months to port to Android, while *The Room Two* took just over 2 months. Along with *The Room Two*, other creepy, atmospheric titles to launch in 2013 included *LIMBO Game* (**Playdead**), along with

TABLE 14.5 iOS versus Android Release Dates for Popular Games by Year

Game Title	iOS Date	Android Date	Port Time
Real Racing 2	12/16/10	12/22/11	>1 year
Words With Friends	09/01/11	09/28/12	>1 year
Super Hexagon	08/31/12	01/19/13	>4 months
The Room Two	12/12/13	02/13/14	>2 months
Monument Valley	04/03/14	05/14/14	>1 month
Lara Croft GO	08/27/15	08/27/15	None
Clash Royale	03/02/16	03/02/16	None

FIGURE 14.14 Screenshots of mobile hits: (a) *Ridiculous Fishing: A Tale of Redemption* (2013), (b) *Monument Valley* (2014), and (c) *Prune* (2015).



(a) (b) (c)

Year Walk and the modern-day, text-based adventure *DEVICE 6*, both by Swedish developer **Simogo**. Strategy games continued to be popular with chart toppers such as *XCOM: Enemy Unknown*, *Rymdkapsel*, and 17-Bit's *Skulls of the Shogun*. Frogmind's *Badland* satisfied endless runner fans, while one of the best casual titles of the year was the hilariously fun *Ridiculous Fishing: A Tale of Redemption* by Dutch development studio Vlambeer (Figure 14.14a).

By 2014, the number of global Android users had reached double that of the total number of Apple's iOS users (Vining, 2014, p. 1). High end smartphones began to be released with 2560 × 1440 "**Quad HD**" resolutions and the following year Sony revealed the **Xperia Z5 Premium** which featured 3840 × 2160 "**4K**" resolution. Before the end of 2015, Microsoft released its **Windows 10 Mobile** operating system, which like on Xbox One, helped to unify the Windows OS across multiple device platforms. These innovations were accompanied by many ground-breaking game releases.

Popular platformers from 2014 included *Traps n' Gemstones*, *Leo's Fortune*, *Thomas Was Alone*, and Terry Cavanagh's *VVVVVV*. Strategy fans received titles from major publishers such as *Hitman GO* (Square Enix Montreal) and the card-based *Hearthstone: Heroes of Warcraft* (Blizzard Entertainment), while the puzzle game genre received the innovative *Monument Valley* by Ustwo Games (Figure 14.14b), *Framed* (Loveshack), and *Threes!* (Sirvo). Other notable titles from 2014 included the casual *Freeway/Frogger*-inspired *Crossy Road: Endless Arcade Hopper* (Hipster Whale), a unique visual novel adventure called *80 Days* by Inkle, and **Scott Cawthon**'s debut of what would become a major survival horror franchise—*Five Nights at Freddy's*.

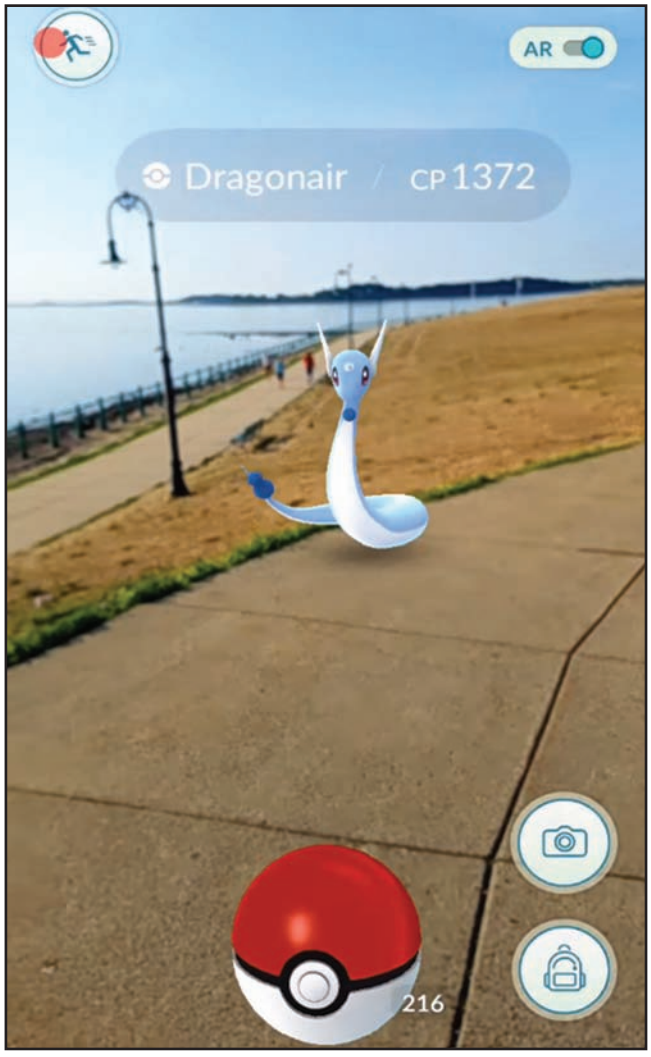
The year 2014 saw the most mobile developer acquisitions to date, such as China's Zhongji Holding buying DianDian Interactive for $960 million, Kentucky-based Churchill Downs Incorporated acquiring Seattle's **Big Fish Games** for $885 million, and social gaming guru Zynga purchasing NaturalMotion for $527 million. These major buyouts slowed down in 2015, but not before **Activision Blizzard** announced it would be purchasing *Candy Crush* developer King for a whopping $5.9 billion.

The year 2015 was another strong year, especially for independent developers with inventive titles such as *Prune* by **Joel McDonald** (Figure 14.14c), *Her Story* by **Sam Barlow**, and *Downwell* by **Moppin**. Square Enix continued its "GO" series with *Laura Croft GO* and *Bastion* developer Supergiant Games finally returned with action RPG *Transistor*. *Alto's Adventure* and *Badlands 2* were solid endless runners, Fireproof completed a trilogy with *The Room Three*, and *Call of Champions* showed that MOBAs could be played in short bursts.

■ RECENT TRENDS

The year 2016 will be remembered as the time that **Nintendo** finally entered the mobile market with the *Miitomo* social app, the breakthrough success of the year, *Pokémon GO* (developed by Niantic Labs) (Figure 14.15), and the endless runner game, *Super Mario Run*. While *Super Mario Run* and *Miitomo* provided decent Nintendo experiences on mobile devices, it was *Pokémon GO* that took the world by storm. "The game—in which players try to capture exotic monsters from *Pokémon*, the Japanese cartoon franchise—uses a combination of ordinary technologies built into smartphones, including location tracking and cameras, to encourage people to visit public landmarks, seeking virtual loot and collectible characters that they try to nab" (Wingfield and Isaac, 2016, para. 2).

FIGURE 14.15 Screenshot of *Pokémon GO*.



The game brought **augmented reality (AR)** to mainstream audiences by superimposing the cartoon *Pokémon* monsters over real-life locations seen through the cameras of players' phones. The game's social element led to a phenomenon of gamers going on "*Pokémon* walks" together and/or meeting other players in the physical world. The success of *Pokémon GO* helped mobile games earn six out of the last seven Game Developers Choice Awards for Best Mobile/Handheld Games—beating out dedicated handheld offerings on the Nintendo 3DS and PlayStation Vita as shown in Table 14.6.

DID YOU KNOW?

Pokémon GO set five Guinness World Records for a mobile game in its first month, including "Most revenue grossed," "Most downloaded," "Most international charts topped simultaneously for a mobile game" (for both downloads and revenue), and "Fastest time to gross $100 million by a mobile game" (Swatman, 2016).

Other notable titles from 2016 included the action adventure game *Severed* (DrinkBox Studios), RPG *Crashlands* (Butterscotch Shenanigans), medieval strategy card game *Reigns* (Nerial/Devolver Digital), and Supercell's real-time strategy blockbuster, *Clash Royale*. "*Clash Royale* topped the grossing charts for games released in 2016 in the U.S., generating $277.1 million. *Pokémon GO* was close behind with $270.2 million" (Cowley, 2017, para. 5). These games were international bestsellers as well. Speaking of which, the rise of mobile gaming tournaments in China, coupled with "the success of the first *Clash Royale* tournament in Helsinki in April 2016 both indicate that mobile games could be very well placed for **eSports**" (Newzoo, 2016, p. 7).

In addition to augmented reality making its way into mobile games, **mobile VR** (virtual reality) gained ground in 2016, with mobile VR headsets like the **Samsung Gear VR** (released at the end of 2015 for $99.99). Sales have been strong, with Samsung announcing that the company had sold 5 million Gear VR headsets to date at the 2017 Consumer Electronics Show (CES) (Takashi, 2017A, para. 1). The year 2016 set new financial records with China investing $1.9 billion in game technology and research, along with more than $20 billion spent in mobile game company mergers and acquisitions (Minotti, 2017, para. 2). Two major acquisitions included China's **Tencent**

TABLE 14.6 Game Developers Choice Awards: Best Mobile/Handheld Games

Year	Game Title	Platform
2010	Cut the Rope	iOS, Android (2011), & more
2011	Superbrothers: Sword & Sworcery EP	iOS, Android/Windows
2012	The Room	iOS, Android
2013	The Legend of Zelda: A Link Between Worlds	Nintendo 3DS
2014	Monument Valley	iOS, Android, Windows
2015	Her Story	iOS, Android
2016	Pokémon GO	iOS, Android
2017	Gorogoa	iOS, Android, Switch, Xbox One

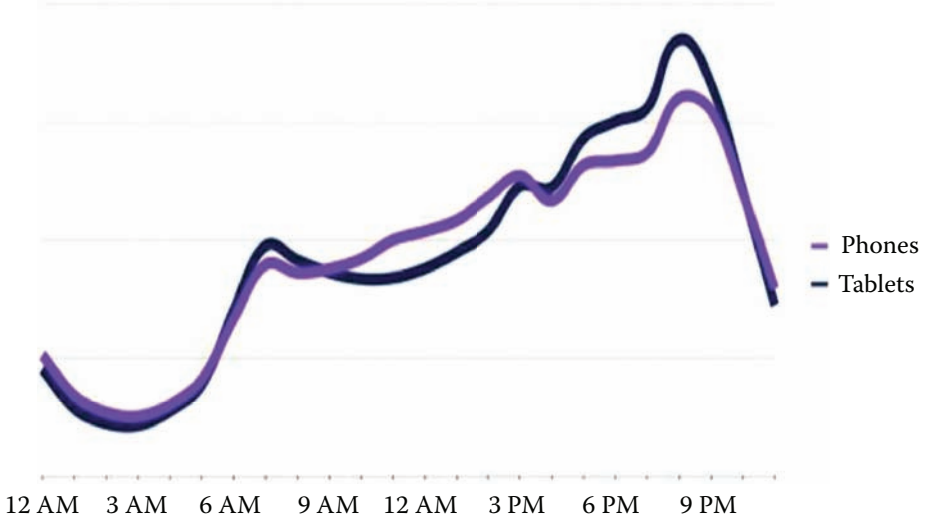
purchasing Finnish developer Supercell for $8.6 billion, followed by China's **Giant Interactive** buying Israeli developer **Playtika** for $4.4 billion.

Convergence continues to be a common trend in mobile technology, with the **Steam app** (released on iOS and Android in 2012) finally landing on Windows Phones in 2016. The Steam app allows users to manage games, browse the storefront, and chat with friends. As for convergence with televisions and home consoles, the *Party Pack* series from **Jackbox Games** was among the first to allow participants to play using their phones or tablets as controllers. In 2017, Sony introduced a series of **PlayLink** titles which allow players to use iOS or Android devices as controllers. Among the first titles to utilize this feature is the crime thriller *Hidden Agenda* by **Supermassive Games**. Other PlayLink titles to look for "include a party game called *That's You* and a new entry in the popular *Singstar* karaoke series" (Byford, 2017, para. 3).

As for *who* plays mobile games, casual puzzle and word games like *Candy Crush Saga* and *Words with Friends* skew toward females over the age of 45, while strategy games like *Clash of Clans* attract a younger male audience with "a significant proportion (about 40%) of players over the age of 35" (Hwong, 2016, para. 3). As for *when* mobile gamers play, a 2017 report by **Flurry Analytics** showed that smartphone and tablet gamers alike follow a similar gaming pattern of playing more often as the day goes on, with peak playtime between 6pm and 9pm (Figure 14.16).

A North American report from **EEDAR** indicated *why*, *where*, and *how* mobile gamers typically play. Among the top five reasons adult mobile gamers play, 83% said it was an "easy way to pass the time," while 65%

FIGURE 14.16 Mobile gaming usage trends (Flurry Analytics, 2017).



play because it is "cheap or free entertainment." About 63% enjoy mobile games because they are "playable anywhere," 53% reported they are "easy to pick up and put down," while 49% play mobile games because they are "playable on a convenient device." As for where or how mobile gamers play, the top three responses included "relaxing at home (other than bathroom, bed, or watching TV)," "in bed, before sleep," and "while watching TV/movies" (EEDAR, 2016, p. 25–26).

Another current trend is *what* platform people are choosing to play mobile games on. A report from Gartner showed that 99.6% of all smartphone sales in the fourth quarter of 2016 were Android and iOS devices, with Samsung leading the Android hardware market (Gartner, 2017). A report from Flurry indicated that larger screen size correlated with longer playing times, with game sessions on large tablets lasting roughly 61% longer than sessions on medium-sized phones (Perez, 2017).

■ MARKET SUMMARY

Mobile and casual gaming have seen tremendous growth since the turn of the century. It was big news in 2002 for WAP gaming when "Digital Bridges announced it had clocked up its 10 millionth session, which accounted for over 70 million minutes of airtime" (Wright, 2016C, para. 12). Then 2003's N-Gage was called a commercial failure but still sold 3 million units (Snow, 2007, para. 2) and was still profitable for Nokia.

Apple made tremendous strides with its iPhone and other iOS products. In January 2012, "Apple reported its best quarterly earnings ever, taking in more than $46 billion over three months. 53% of that revenue was from the sale of 37 million iPhones, at an average selling price of nearly $660" (Golson, 2012, para. 1). Android tablet sales grew from a 45.8% worldwide market share in 2012 to a 61.9% share in 2013 (Gartner, 2014, p. 1). Today, Android "commands over 80 percent of the mobile OS market share globally, and just under 60 percent in the U.S." (Heiman, 2016, para. 1).

Similar to *Pac-Man* in the 1980s, the casual *Angry Birds* became a huge intellectual property, becoming the first mobile game to receive a full-length feature film when Columbia Pictures and Rovio Animation released *The Angry Birds Movie* on May 20, 2016. Even before the movie, stores were flooded with *Angry Birds* stuffed animals and other **ancillary products**—from toys and board games, to backpacks and other school supplies. *Five Nights at Freddy's* was another mobile franchise that saw numerous dolls and products based off its game characters.

Research by **SuperData Research** and **Unity Technologies** revealed that mobile games set a new record in 2016, generating more than $40.6 billion in worldwide revenue—an 18% increase from 2015. "That money is equal to all global movie box office sales during the same time" (Takashi, 2017B, para. 1). Furthermore, Newzoo estimated "that mobile gaming generated 37% of total global video game revenue in 2016, rising 21.3% year over year and surpassing PC revenue for the first time ever" (Tenebruso, 2017, para. 15). See Table 14.7 for the top mobile games of 2017.

TABLE 14.7 Top U.S. Mobile Games as of Fall 2017 (Think Gaming, 2017)

Top Free Games		**Top Grossing Games**	
1	Homescapes (Playrix Games)	1	Candy Crush Saga (King)
2	Super Mario Run (Nintendo Co., Ltd.)	2	Clash of Clans (Supercell)
3	Snake VS Block (Voodoo)	3	Candy Crush Soda Saga (King)
4	Flip Master (Miniclip Com)	4	Pokémon GO (Niantic Inc.)
5	Rolly Vortex (Voodoo)	5	Crash Royale (SuperCell)

■ ACTIVITY: MOBILE MULTIPLAYER

There are many ways gamers and game fans can get together and share a mobile gaming experience. Let's play one of these games together and discuss the experience.

GUIDELINES

A smartphone will be necessary for each person in this activity. Choose what game everyone would like to participate in and download the appropriate app. Note that most of these online platforms require a user account, so participants must be willing to create an account to proceed. Spend 30 minutes or so engaged in the mobile game, communicating only through mobile devices and not verbally in the room. Then take an additional 20–30 minutes to conduct a group SWOT analysis of the experience.

■ CHAPTER 14 QUIZ

1. Which of the following is not a common characteristic of a casual game?
   a. Easy to learn, with relatively few rules
   b. Simple gameplay (often requiring just one finger)
   c. Can be played in short bursts of time
   d. Targeted towards a narrow audience

2. Considered the first smartphone, with features like an address book, appointment scheduler, calculator, calendar, notepad, and world time clock:
   a. Psion Organiser
   b. IBM Simon
   c. PalmPilot
   d. BlackBerry 850

3. Helped lead the mass adoption of the first smartphones in Japan with its subscription-based online gaming platform called i-mode in 1999:
   a. NTT DoCoMo
   b. KDDI
   c. Softbank
   d. Hagenuk Corporation

4. Aside from ports of *Tetris*, this game programmed by Finnish developer Taneli Armanto for the Nokia 6110 was one of the first mainstream mobile games:
   a. Bejeweled
   b. Sorcery
   c. Snake
   d. Void Raider

5. The original Nokia N-Gage featured a game card slot that was located:
   a. On the top of the device, near the speaker
   b. Inside of its pop-out video screen
   c. Inside its battery compartment
   d. None of the above

6. Which of the following was not true of the Tiger Telematics Gizmondo?
   a. Featured a slot for a SIM card
   b. Supported WAP, GPRS, and SMS/MMS
   c. Was a technically superior game machine to N-Gage
   d. Sold more than 50,000 units worldwide

7. Pioneered the smartphone revolution with its multimedia features and App Store:
   a. Apple iPhone
   b. Samsung Galaxy
   c. Windows Phone
   d. None of the above

8. The first mobile service provider used by Apple for the iPhone:
   a. AT&T (then Cingular Wireless)
   b. Sprint
   c. T-Mobile
   d. Verizon

9. A common monetization method used by modern mobile games:
   a. Pay once/non-freemium
   b. Free with ad support, a.k.a. Free-to-play (F2P)
   c. Freemium
   d. All of the above

10. Popularized the tile-matching genre on mobile, often called "match three" games:
    a. Candy Crush Saga
    b. Clash of Clans
    c. Fruit Ninja
    d. Words With Friends

11. Which of the following titles is not an "endless runner" style of game?
    a. Alto's Adventure
    b. Jetpack Joyride
    c. Laura Croft GO
    d. Super Mario Run

12. By this year, high end smartphones began to be released with 2560 × 1440 "Quad HD" resolutions and there were more than double the number of Android users compared to iOS users:
    a. 2010
    b. 2012
    c. 2014
    d. None of the above

13. One of the biggest mobile releases of 2016, bringing augmented reality (AR) to mainstream audiences and its social element led to a phenomenon of players going for walks together and/or meeting other players in the physical world:
    a. Clash Royale
    b. Mini Metro
    c. Pokémon GO
    d. Super Mario Run

14. In 2017, Sony introduced a series of _____ titles (such as *Hidden Agenda* by Supermassive Games) allowing players to use iOS or Android devices as controllers.
    a. PlayLink
    b. PlayMobile
    c. Kickstarter
    d. RedTooth

15. Today, Android commands more than _____ of the mobile OS market share across the globe, with just below a 60% market share in the United States.
    a. 40%
    b. 50%
    c. 70%
    d. 80%

True or False

16. Early mobile games used the primitive Wireless Application Protocol (WAP) as the standard technology for connecting to the Internet.

17. The N-Gage Platform (also called "N-Gage 2.0") was a flip phone version of the original, dedicated N-Gage gaming phone.

18. In the mobile gaming world, "fragmentation" is the result of different platforms using different operating systems, which results in more work for developers to port games.

19. The first generation of iPhones did not include Multimedia Messaging Service (MMS) support for sending or receiving multimedia messages.

20. A common trend with early mobile games was to develop games first on Android and then port them over to iOS after the bugs were worked out.

■ FIGURES

Figure 14.1 "Smart" devices: (a) IBM Simon, (b) PalmPilot with stylus, and (c) BlackBerry 850 pager. (Blackberry_850 1999年発売・初代モデル) _2014-01-30_17-54.jpg, by Lutra98railway - [1], CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=30883500. Retrieved from https://commons.wikimedia.org/wiki/File:Blackberry_850%EF%BC%881999%E5%B9%B4%E7%99%BA%E5%A3%B2%E3%83%BB%E5%88%9D%E4%BB%A3%E3%83%A2%E3%83%87%E3%83%AB%EF%BC%89_2014-01-30_17-54.jpg)

FIGURE 14.2 Snapshot of *Snake* (1997) by Wardyga.

FIGURE 14.3 Nokia N-Gage handheld game console and mobile phone. ("The Nokia N-Gage, a device that combined gaming, mobile phones and tacos. This mobile phone and handheld gaming hybrid

came out in 2003 and was followed by the N-Gage QD a year later. It was not successful as a phone or a gaming platform." By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=33692791. Retrieved from https://en.wikipedia.org/wiki/N-Gage_(device)#/media/File:Nokia-NGage-LL.jpg)

FIGURE 14.4 Screenshots of N-Gage launch titles (a) *Puyo Pop*, (b) *SonicN*, and (c) *Tomb Raider: Starring Laura Croft*. (*Puyo Pop* courtesy of Sega, 2003; *SonicN* courtesy of Sonic Team/Sega, 2003; and *Tomb Raider* courtesy of Ideaworks3D/Nokia, 2003.)

FIGURE 14.5 Screenshots from one of the banned Nokia commercials from 2003 by Wardyga.

FIGURE 14.6 Print advertisement for the N-Gage QD in 2005. (Retrieved from *Maximum PC*, December 2005, page 113.)

FIGURE 14.7 Five of the best N-Gage titles: (a) *Rayman 3*, (b) *Pathway to Glory*, (c) *The Sims Bustin' Out*, (d) *Glimmerati*, and (e) *Tom Clancy's Splinter Cell: Chaos Theory*. (*Rayman 3* courtesy of Gameloft, 2003; *Pathway to Glory* courtesy of RedLynx/Nokia, 2004; *The Sims Bustin' Out* courtesy of Ideaworks3D/EA Games; *Glimmerati* courtesy of Bugbear/Nokia, 2005; and *Tom Clancy's Splinter Cell: Chaos Theory* courtesy of Gameloft/Nokia, 2005.)

FIGURE 14.8 Early mid-2000s mobile hits: (a) *Prince of Persia: The Sands of Time* (Gameloft), (b) *The Fast and the Furious,* (Digital Bridges), and (c) *Tower Bloxx* (Sumea/Digital Chocolate). (*Prince of Persia: The Sands of Time* courtesy of Gameloft, 2004; *The Fast and the Furious* courtesy of Digital Bridges, 2004. "A Brief History of Mobile Games: 2005 - Making a big splash" by Chris Wright December 31st, 2008. *The Fast and the Furious* (Digital Bridges). Retrieved from http://www.pocketgamer.biz/feature/10710/a-brief-history-of-mobile-games-2004-money-for-nothing/; and *Tower Bloxx* courtesy of Sumea/Digital Chocolate, 2005. *Tower Bloxx* (Digital Chocolate). Retrieved from http://www.pocketgamer.biz/feature/10719/a-brief-history-of-mobile-games-2006-squaring-the-3d-circle/)

FIGURE 14.9 Gizmondo (2005). (Courtesy of Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=12391181. Retrieved from https://en.wikipedia.org/wiki/Gizmondo#/media/File:Gizmondo.jpg)

FIGURE 14.10 Advertisement for the original Apple iPhone in 2007. ("Apple iPhone Turns 8: How Steve Jobs' Smartphone Changed The World In Less Than A Decade" by Mike Brown June, 29, 2015. International Business Times. Photo Credit: Apple)

FIGURE 14.11 Screenshots of early iOS games: (a) *Rolando* (2008) and (b) *Angry Birds* (2009). (*Rolando* courtesy of HandCircus/ngmoco, 2008; and *Angry Birds* courtesy of Rovio Entertainment, 2009.)

FIGURE 14.12 Screens of multiplatform hits (a) *Fruit Ninja* and (b) *Plants vs. Zombies* (2010). (*Fruit Ninja* courtesy of Halfbrick, 2010; and *Plants vs. Zombies* courtesy of PopCap Games/Electronic Arts 2010.)

FIGURE 14.13 Screenshots of (a) *Clash of Clans* and (b) *Candy Crush Saga* (2012). (*Candy Crush Saga* courtesy of King, 2012; and *Clash of Clans* courtesy of Supercell, 2012.)

FIGURE 14.14 Screenshots of mobile hits: (a) *Ridiculous Fishing: A Tale of Redemption* (2013), (b) *Monument Valley* (2014), and (c) *Prune* (2015). (*Ridiculous Fishing: A Tale of Redemption* courtesy of Vlambeer, 2013; *Monument Valley* courtesy of Ustwo Games, 2014; and Prune courtesy of Joel McDonald, 2015.)

FIGURE 14.15 Screenshot of *Pokémon GO* (Niantic/Nintendo, 2016) by Wardyga.

FIGURE 14.16 Mobile gaming usage trends (Flurry Analytics, 2017). ("Mobile gaming sessions down 10 percent year-over-year, but revenue climbs." Posted Jun 21, 2017 by Sarah Perez. Retrieved from https://techcrunch.com/2017/06/21/mobile-gaming-sessions-down-10-percent-year-over-year-but-revenue-climbs/)

Pro File: Steve Jobs. Photo credit: "Steve Jobs holding a MacBook Air (at MacWorld Conference & Expo 2008. Moscone Center, San Francisco, CA)" by Matthew Yohe. Own work (Original text: self-made), CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=6022486. Retrieved from https://en.wikipedia.org/wiki/Steve_Jobs#/media/File:Steve_Jobs.jpg.

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Modern Console Gaming

OBJECTIVES

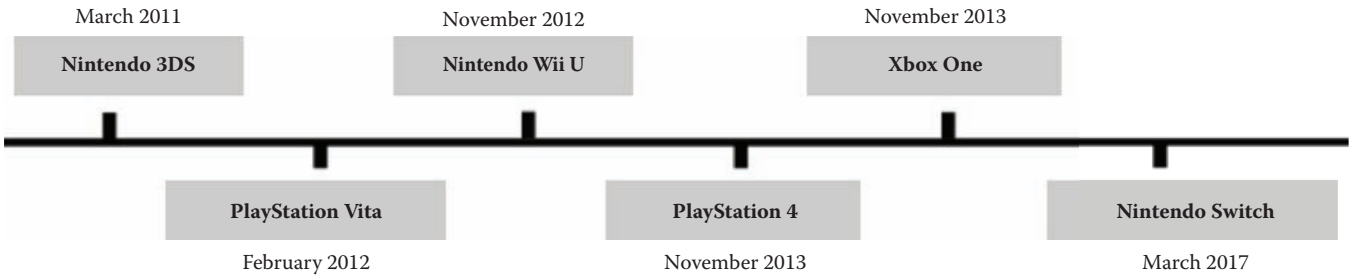
After reading this chapter, you should be able to:

- List several innovations introduced to gaming during this time period.
- Have a sense of graphics and other capabilities of modern video games.
- Be familiar with the technological differences among recent game systems.
- Summarize a brief overview of what made each video game console unique.
- List some of the key video game titles and peripherals for each console.
- Recognize the importance the new technology had on the video game industry.
- Be familiar with the handheld systems released during this time period.
- Acknowledge the people who helped pave the way for these games and consoles.
- Explain why virtual reality failed to become as popular as traditional gaming.
- Summarize modern video game market sales.
- Account for fluctuations in market positions among leading manufacturers.
- Describe the breakthroughs and trends in gaming during this era.

■ KEY TERMS AND PEOPLE

343 Industries
3DS series
4K
Alexa & Siri
amiibo
API
APU
Asymmetrical
AT&T
Attach rate
Augmented reality
Autostereoscopic
Beam
Bonaire GPU
Bungie
Jason Camberis
Capacitive touchpad
Casual games
Mad Catz
Mark Cerny
Chat Headset
Cloud gaming
Club Nintendo
Clubs (on XBL)
Compute units
Cortana
Dashboard
Dave & Buster's
Day one patch
Digital-only
DeNA
DirectX
DLNA
DRM
DualShock 4
Durango
Dynamic Menu
E3 conference
Elite controller
Espresso CPU
Reggie Fils-Aime
Flash ROM cartridges
FLOPS
GameDVR
Graphics Core Next
Hair Trigger Locks
HDR10 high-dynamic-range color
Impulse triggers
Intellectual property
Satoru Iwata
Jaguar CPU
Joy-Con
Tatsumi Kimishima
Kinect 2.0
Latte GPU
Carl Ledbetter
Don Mattrick
Miiverse
Mojang
Bandai Namco
NetFront
New Xbox One Exp.
NFC
Nintendo 3DS
Nintendo eShop
Nintendo Network
Nintendo Switch
Nintendo World
Off-TV Play
OLED
OneGuide
OOE
Orbis
Picture-in picture
Pitcairn
Play Anywhere
Play Mechanix
Playdead
PlayStation 4
PlayStation Camera
PlayStation Move
PlayStation Now
PlayStation Plus
PlayStation VR
Project Café
Project Scorpio
PS Vita/Card/2000
Raw Thrills
Region-locked
Remedy Ent.
Remote Play
Sega
Share Play
Snap
Specular Interactive
SpotPass & StreetPass
Stream processors
Tetsu Sumii
SuperData Research
John Taylor
The Coalition
TV Control
Twitch
Ultra HD Blu-ray
Ustream
Videmption
Virtual Console
Wii U/GamePad
Wii U Pro Controller
Xbox App/Smartglass
Xbox Live Gold
Xbox One
Mike Ybarra
Shuhei Yoshida
Zynga

■ CONSOLE TIMELINE



■ THE MODERN ARCADE

The U.S. arcade scene remained steady into 2010 and saw a number of titles by Illinois-based newcomer **Raw Thrills**. The developer/publisher of *The Fast and the Furious* (2004) game partnered up with other U.S. developers such as **Play Mechanix** and **Specular Interactive** to release hit arcade games such as *Big Buck Safari* (2008), *H2Overdrive* (2009), and *Terminator Salvation* (2010) (Figure 15.1a) among other movie-based titles. **Sega** continued to turn out hit machines and **Bandai Namco** saw the bulk of its earnings from arcade games such as *Deadstorm Pirates* (2010), *Tekken Tag Tournament 2* (2011) and *Dark Escape 4D* (2012). Subsequent arcade successes included *Mario Kart Arcade GP DX* (2013), *Star Wars: Battle Pod* (2014) (Figure 15.1b), and *Tekken 7* (2015).

Except for fighting games, the modern era of arcades implemented the business strategy of *not* porting arcade games to home consoles. Maintaining many of these games as exclusives in the arcades has given many gamers a reason to return to them. Another trend that may have helped attract people back to the arcade scene was the rise of **casual games** made popular by online and mobile gaming, as well as indie games and the Nintendo Wii. The style of these casual games was not unlike the arcade hits of yesteryear, leading to retro game revivals such as the 108-inch *World's Largest Pac-Man* and *Galaga Assault* in 2016. Most coin slots changed to **card readers** and a number of games began to combine video gaming with redemption (for tickets or points), creating hybrid machines known as video redemption or **"videmption"** games.

Larger companies like **Dave & Buster's** operated more than 80 venues as of 2016. Unlike other arcade/restaurant or bar combos whose primary source of revenue has been from food and drinks, dining and beverage income for Dave & Buster's typically makes up around 46.8% of all revenues—with amusement and other revenues taking in 53.2% of earnings. Upon further analysis, 78.3% of this "amusement and other revenues" figure came from redemption games, while only 18% of these earnings came from simulation and video games (Dave & Busters, 2016, p. 5). Arcades in the United States may not be dead, but it is no longer video games that are keeping them alive.

DID YOU KNOW?

Arcade Deluxe created by **Jason Camberis** holds the Guinness World Record for "Largest Arcade Machine" standing over 14 feet tall and nearly 6 1/2 feet wide (Guinness World Records, 2015, p. 176). It can play more than 250 classic arcade games from Atari, Capcom, Midway, Namco, Sega, SNK, Taito, and Tecmo.

■ MODERN CONSOLE GAMING

After a longer than usual life cycle for the seventh generation of video games, the modern gaming era began—like before—with the release of handheld systems by Nintendo and Sony. The **Nintendo 3DS** launched on February 26, 2011 in Japan and late March in most other

FIGURE 15.1 Screenshots of arcade hits (a) *Terminator Salvation* and (b) *Star Wars: Battle Pod.*

(a)

(b)

countries. The **PlayStation Vita** was released in Japan on December 17, 2011 and in mid-to-late February in other regions. Likely due to greater competition by mobile devices, handheld sales were initially slow but eventually gained momentum. For home consoles, this era marked the first time that all major video game systems debuted in North America either before or simultaneous to their Japanese and European launches. As for tech specs, **FLOPS** (floating point operations per second) became more important than polygon counts as indicators for processor speeds and console comparisons.

■ WII U

Codenamed **"Project Café"** and sometimes called "Wii HD" by journalists, Nintendo's **Wii U** (Figure 15.2) was introduced in the United States on November 18, 2012 at the **Nintendo World** store in Times Square. It was Nintendo's second console to debut in North America along with the original Wii, and the company's first high definition system. Two versions of the console were made available including the $299 **Basic set** bundled with a white controller and console with 8 GB of internal flash storage, along with a sensor bar, stylus, AC cables and an HDMI cable. The $349 **Deluxe set** (Figure 15.3) (called "Premium" outside of the United States) featured a black controller and console, plus "32 GB of local storage, a Wii U controller charging cradle, Wii U console stand and a copy of *Nintendo Land*" (Burns, 2012, para. 4). Early press from sources like *The Wall Street Journal* indicated that Nintendo aimed to attract both casual and hardcore gamers alike with its new system (Lejacq, 2012).

As for the name, Nintendo of America president **Reggie Fils-Aime** announced; "It's a system we will all enjoy together but also one that's tailor-made for you… Is it unique, unifying, maybe even utopian? The answer is also yes to all of this" (Sutter and Gross, 2011, para. 8). Along with this perplexing description, naming it "Wii U" was kind of a paradox. It capitalized on the successful Wii brand but in doing so may have turned off hardcore gamers who were already disconnected from the original Wii. Its slogan was "How U will play next," written as a question "How will U play next?" in PAL regions.

Early promotional videos showed the Wii U being used with the traditional Wiimote, leading many consumers to believe the Wii U was only an upgrade from the original Wii. This was not helped by Nintendo's emphasis on its tablet-style **GamePad**, which was the focal point in most Wii U advertising. For consumers who understood the new concept, the Gamepad's 6.2-inch, 854 × 480 resolution touch screen brought many innovations to gaming. Key features included its

FIGURE 15.2 Nintendo's Wii U console with touchscreen-enabled Wii U GamePad.

FIGURE 15.3 Wii U print advertisement showing Deluxe set with black hardware (2012).

ability to stream games and movies from the console without a TV (called **Off-TV Play**), easier web browsing, and serving as a second screen for **asymmetrical**, multiplayer gaming. The GamePad could also be used as a secondary screen for maps, similar to how the dual screens have been used on the Nintendo DS.

Beyond the touchscreen and a camera, the GamePad featured motion controls and a familiar button/control stick layout. New features included an **NFC (near-field communication)** reader/writer which could interact with compatible cards and figurines, as well as a **TV Control** button which allowed the GamePad to control most TVs and set-top boxes. On the downside, the GamePad only worked within about 15 feet of the console, reducing the portability potential many gamers had anticipated.

The Wii U was built to be fully backward compatible with all Wii software and accessories. And even without counting the five **digital-only** games, the system's 34 launch titles (Table 15.1) were the most ever for a home console. This fact may have gone unnoticed because

TABLE 15.1 Wii U U.S. Launch Titles (*digital-only)

- Assassin's Creed III
- Batman: Arkham City Armored Ed.
- Ben 10: Omniverse
- Call of Duty: Black Ops II
- Chasing Aurora*
- Darksiders II
- Epic Mickey 2: The Power of Two
- ESPN Sports Connection
- FIFA Soccer 13
- Funky Barn
- Game Party Champions
- Just Dance 4
- Little Inferno*
- Madden NFL 13
- Mass Effect 3: Special Edition
- Mighty Switch Force! Hyper Drive Ed.*
- Nano Assault Neo*
- NBA 2K13
- New Super Mario Bros. U (Figure 15.4a)
- Ninja Gaiden 3: Razor's Edge
- Nintendo Land (Figure 15.4b)
- Rabbids Land
- Scribblenauts Unlimited
- SING Party
- Skylanders: Giants
- Sonic & All-Stars Racing Transformed
- Tank! Tank! Tank!
- Tekken Tag Tournament 2: Wii UEd.
- Transformers Prime: The Game
- Trine 2: Director's Cut*
- Warriors Orochi 3 Hyper
- Wipeout 3
- Your Shape: Fitness Evolved 2013
- ZombiU

more than half of those games had been released on other consoles prior to or simultaneously with the Wii U's launch. While exclusives like *Nintendo Land* and *ZombiU* demonstrated the system's potential, many other launch titles did not.

More than 400,000 units were sold during the first week of the Wii U launch (Matthews, 2012). Like the original Wii, Nintendo's strategy with the Wii U was focused on innovative gameplay rather than being a technological powerhouse. It was superior to preexisting hardware by Microsoft or Sony, but those companies would be releasing successors to the Xbox 360 and PS3 the following year. While its internal flash memory may have seemed small, the Wii U was built with an SD card slot and four USB ports capable of expanding its capacity to 2 **terabytes (TB)**. For software, its slot-loading optical disc drive supported 25 GB proprietary Wii U discs, as well as original Wii discs.

FIGURE 15.4 Screens of Wii U launch titles (a) *New Super Mario Bros. U* and (b)*Nintendo Land*.

(a) (b)

DID YOU KNOW?

The Wii U was the first home console by Nintendo to be physically larger than its predecessor but used less energy than the Wii (at 37 kWh/year vs. Wii's 40 kWh/year).

The console's online features could be accessed through the **Nintendo Network,** which did not charge players a monthly subscription fee. Key network apps included **Virtual Console** for downloading games; **Nintendo eShop** where players could utilize **Nintendo TVii** to search for programs on local TV, as well as video streaming services like Netflix and Amazon Video; and the social networking service **Miiverse**, where gamers could share content or use their GamePad's inner-facing camera to video chat with friends. The Nintendo Network also included access to the **Club Nintendo** loyalty program and an Internet browser, which was one of the best console web browsers and extremely easy to use with the GamePad's tablet-style design.

Possibly because of the system's backward compatibility with all original Wii accessories, the Wii U did not have as many original controllers and peripherals of its own. Aside from the GamePad, the **Wii U Pro Controller** was a more traditional game pad with a similar shape to the Xbox 360 controller. Other notable Wii U controllers included the Nintendo GameCube controller *Super Smash Bros.* Edition and the *Tekken Tag Tournament 2* Arcade Stick by **Mad Catz**. Controller accessories included the Mad Catz Wii U GamePad Grip & Guard, NERF Armor for Wii U GamePad, GameCube Controller Adapter, and Wii U GamePad Stand/Cradle Set.

Beyond controller-related peripherals, the Wii U had its share of headsets, battery packs, styluses, screen filter and protector sets, and **amiibo** carrying cases. Like Activision's *Skylanders* series, Nintendo developed its own series of figurines called "amiibo" to play with games like *Super Smash Bros. for Wii U*. Once purchased, the player would scan the base of the figurine on the GamePad's NFC reader (marked with a rectangle below the d-pad), register and name the amiibo—thus importing a virtual, playable version of that figurine into the game.

HEAD-TO-HEAD

In addition to the *Skylanders* games, there were many cross-platform titles released on the Wii U and its competitors. To compare the performance of the Wii U, Xbox 360, and PS3, check out each system's version of *Assassin's Creed IV, Batman: Arkham City, Call of Duty: Black Ops II, Darksiders II, Rayman Legends*, and *Watchdogs*.

■ CONSOLE COMPARISON: WII U VERSUS XBOX 360 AND PS3

The Wii U was the dominant machine compared to the PS3 and Xbox 360; however, these consoles were already 6 and 7 years old. Powering the Wii U was the coffee-themed IBM **PowerPC Tri-Core "Espresso"** CPU running at **1.24 GHz**, along with the **550 MHz AMD Radeon "Latte"** GPU capable of **320 shaders** (Table 15.2). While the CPU may seem a lot slower compared to the 3.2 GHz processors found in the PS3 and Xbox 360, the Espresso was the first home console CPU to utilize **OOE (Out of Order Execution)** (Albert, 2013, para. 8). This process allowed it to carry out instructions in a nonlinear fashion (preloading data in the background), making it much more efficient than previous consoles.

TABLE 15.2 Wii U Tech Specs

Manufacturer:	Nintendo, Foxconn, and Mitsumi
Launch Price:	$299.99 (4 GB) and $349.99 (32 GB, NNP, and Nintendo Land)
Release Date:	11/18/12 (NA), 11/30/12 (EU), 12/08/12 (JP)
Format:	5x proprietary Wii U optical disc (25 GB) + Wii discs
Processors:	IBM PowerPC Tri-Core "Espresso" CPU (1.24 GHz) AMD Radeon "Latte" GPU (550 MHz with 320 shaders)
Performance:	Up to 1080p HD and 352 GFLOPS | GamePad = 3–5 h battery
Memory:	2 GB DDR3 RAM + 8 or 32 GB internal flash storage
Sound:	5.1 Linear PCM surround or analog stereo via HDMI

The CPU was also heavily supported by its Latte graphics processor, which carried the bulk of the load.

On paper, the Latte appears to be barely superior to the 500 MHz ATI Xenos in the Xbox 360 and equal to the 550 MHz Nvidia-based SCEI RSX Reality Synthesizer in the PS3. However, with nearly double the amount of accessible RAM to work with, the Latte could push approximately **352 GFLOPS**—compared to around 230 on PS3 and 240 on the 360. To look at it from another angle, the Wii U's GPU contained 320 shaders and **stream processors** (responsible for traditional graphics rendering tasks and general-purpose number crunching), giving it approximately 1.5 times the raw shader power compared to the Xbox 360 (Leadbetter, 2013, para. 5–6).

For software, the Wii U used proprietary optical discs that could store up to 25 GB of data—comparable to the Blu-ray discs of the PS3. Its faster optical drive could "read discs at a 22 MB/s compared to the 360's 15.85 MB/s (DVD) and the PS3's 9 MB/s (Blu-ray) speeds" which meant faster load times (Wong, 2012, para. 1). On the other hand, the Wii U lacked many its competitor's features, including no trophy/achievement system, no optical audio output, and no DVD or Blu-ray support.

■ KEY WII U TITLES

The Wii U had hundreds of games available on its eShop but was severely lacking when it came to physical releases. By late 2016, Nintendo had only released 39 games in the United States, along with just 118 manufactured titles by third-party developers (Plunkett, 2016, para. 7). Among the first-party releases were the return of longtime franchises like *Super Mario, Donkey Kong*, and *Zelda*—along with sequels to Wii games such as *Wii Fit U, Wii Party U*, and *Wii Sports Club.* Mario remained the biggest star, with the console's best-selling titles being *Mario Kart 8, New Super Mario Bros. U*, and *Super Mario 3D World* (shown in Figure 15.5).

The console's more unique experiences were found in titles that used the GamePad in creative ways. For example, in *Call of Duty: Black Ops*, gamers could engage in asymmetrical gameplay with one player using the GamePad screen and one player using the TV, which eliminated having to play the game in split screen mode on a single screen. Another interesting use of the GamePad was how the tablet could be used as a drawing pad in *Art Academy: SketchPad* or as a canvas for designing level layouts in *Super Mario Maker*. Similar to Sony's *LittleBigPlanet*, players could create their own levels in *Super Mario Maker* and then share them online with the rest of the world.

Last, the Wii U was home to a number of exceptional exclusive titles including *Bayonetta 2, Super Smash Bros. for Wii U, Xenoblade Chronicles X, Pikmin 3, Donkey Kong Country: Tropic Freeze*, and *Splatoon*. It was also the only home console featuring downloadable/indie gems like *Shantae: Risky's Revenge – Director's Cut, FAST Racing NEO, Runbow, Year Walk, Affordable Space Adventures*, and *Little Inferno*—and was the exclusive console for *Shovel Knight* during the game's first 10 months on the market.

FIGURE 15.5 Box art to five Wii U hits including from: (a) *Super Mario 3D World,* (b) *Rayman Legends,* (c) *Super Smash Bros. for Wii U,* (d) *Bayonetta 2*, and (e) *Mario Kart 8.*

(a) (b) (c) (d) (e)

HANDHELD SNAPSHOT: NINTENDO 3DS

The 3DS (Figure 15.6) was released in the United States on March 27, 2011 for $249. While the PSP won out in some areas, the 3DS was technically superior overall (Table 15.3). Its key feature was an **autostereoscopic** upper screen that could display stereoscopic 3D effects without 3D glasses. Other new features included an analog "C-Stick," **StreetPass** and **SpotPass** data systems, **augmented reality (AR)**, plus apps such as Virtual Console, Nintendo eShop, YouTube, and Netflix. It was also backward compatible with DS video game cards.

A larger **3DS XL** was released after one year, increasing each screen size by more than a full inch. Over the next few years, Nintendo introduced a **2DS**, **New Nintendo 3DS**, and "new" **XL** model—the latter two featuring 804 MHz quad-core ARM11 processors and twice the amount of memory. After a slow start, Nintendo went on to dominate the handheld market yet again with more than 64 million 3DS systems sold for an 80% market share (VGChartz, 2017). See Figure 15.7 for some of the best titles.

FIGURE 15.6 Nintendo 3DS.

TABLE 15.3 Nintendo 3DS Tech Specs

Format:	Game Card (1–8 GB)/mAh lithium-ion battery (3–5 h)
Processors:	Dual-Core ARM11 (268 MHz) + Single-Core ARM9 (134 MHz)
	Digital Media Professionals PICA200 GPU (268 MHz)
Performance:	16.77 million colors, 15.3 million PPS at 200 MHz, 4.8 GFLOPS
Memory:	128 MB FCRAM, 6 MB VRAM, and 1 GB internal flash memory
Resolution:	800 × 240 (3.53" 3D LCD) and 320 × 240 (3.00" touchscreen LCD)
Sound:	Stereo speakers (pseudo-surround)/3.5 mm mic/phones jacks

FIGURE 15.7 Five 3DS hits: (a) *Super Mario 3D Land,* (b)*Pokémon Sun,* (c)*The Legend of Zelda: A Link Between Worlds,* (d)*Fire Emblem: Awakening*, and (e)*Metroid: Samus Returns.*

(a) (b) (c) (d) (e)

■ PLAYSTATION 4

Codenamed **"Orbis"** after its operating system, the **PlayStation 4 (PS4)** (Figure 15.8) debuted on November 15, 2014 in North America for $399 and over the following weeks in other countries. For the launch party, "Sony's PR team rented out New York's Standard High Line Hotel, filling every room [including the showers] with PlayStation branded regalia. Around 500 gamers showed up to receive their preordered consoles and were given free food, T-shirts, and time with game demos while they waited" (Huffman, 2013, para. 3). The launch would earn Sony a new record for fastest-selling game console with 1 million units sold in the United States in its first 24 hours, in addition to 250,000 systems sold within 48 hours in the United Kingdom (Guinness World Records, 2015, p. 178).

Bundled with the original console was a **DualShock 4** controller, power cable, HDMI cable (a first for Sony), Micro-USB cable, savings voucher, and a small, mono earbud headset with a microphone and shirt clip. Fronted by lead architect and producer **Mark Cerny** (*Crash Bandicoot/Ratchet & Clank*), the technology in the PS4 was a refreshing change from the complex microarchitecture of PS3's Cell Processor. Behind its power was an AMD **Accelerated Processing Unit (APU)**, which included an 8-Core **x86-64 "Jaguar"** CPU and Radeon **Graphics Core Next** GPU on a single chip. AMD's head of marketing **John Taylor** claimed the PS4's chip was the most powerful APU the company had built to date with its number of cores and teraflops (Moss, 2013, para. 3).

TABLE 15.4 Sony PlayStation 4 U.S. Launch Titles (*digital-only)

- Angry Birds Star Wars
- Assassin's Creed IV: Black Flag
- Battlefield 4
- Blacklight: Retribution*
- Call of Duty: Ghosts
- Contrast*
- DC Universe Online*
- FIFA 14 (Figure 15.9a)
- Flower*
- Injustice: Gods Among Us -Ultimate Ed.
- Just Dance 2014
- Killzone: Shadow Fall
- Knack
- Lego Marvel Super Heroes
- Madden NFL 25
- NBA 2K14
- Need for Speed: Rivals
- The Playroom* (preinstalled)
- Resogun* (Figure 15.9b)
- Skylanders: Swap Force
- Sound Shapes*
- Super Motherload*
- Trine 2: Complete Story*
- Warframe*

As for its initial games (Table 15.4), 10 of the console's 24 launch titles were digital-only, including *The Playroom* which came preinstalled on every PS4 system to show off its optional camera and DualShock 4 gamepad capabilities. The game consists of three augmented reality mini-games which could project the player(s) onto the TV screen to interact with superimposed robots or engage in a game of virtual air hockey.

Sony added a number of new features to the DualShock 4 controller, which was designed with input

FIGURE 15.8 Sony PlayStation 4 with DualShock 4 controller.

FIGURE 15.9 Screenshots from PlayStation 4 launch titles (a) *FIFA 14* and (b) *Resogun*.

(a)

(b)

from former *Halo/Destiny* developer **Bungie** (Rougeau, 2014, para. 7). The gamepad includes a clickable, two-point **capacitive touchpad** for gameplay mechanics such as navigating the map on *Assassin's Creed IV: Black Flag* or calling "quick plays" in *NBA 2K14*. The top of the controller adds a **light bar** (shown in Figure 15.10) with three LEDs that displays different colors to provide the player with certain information. For example, when four controllers are active, player one is illuminated in blue, player two is red, player three is green, and player four is pink. Another use of the light bar is in *Grand Theft Auto V* where it flashes red and blue when the player is being pursued by police.

Other features include a 3.5 mm stereo headset jack (like Xbox 360's controller), a mono speaker (like on the Wiimote), and a merged Start/Select button called **"Options"** to make room for a new **"Share" button** for players to upload screenshots and videos of their last 15 minutes of gameplay on social networking sites (Hsu, 2013, p. 2). The redesigned analog sticks feature convex dome caps and the L2 and R2 triggers (which are the only two buttons to retain pressure sensitivity) were curved inward like on Xbox controllers. Everything from the d-pad, to the spacing around the face buttons, to the curvature of the handles, was rethought and updated for the DualShock 4.

The casing for the PS4 was designed by **Tetsu Sumii** who aimed to create "a simple object in the living room" that was "beautiful from all sides" (Codd, 2013, p. 2). Sony stayed with Blu-ray as its primary optical media, and while the PS4 can also play DVDs, it is not backward compatible with PS3 discs and cannot play music CDs. As a first for home consoles, the PS4 requires **mandatory installation** to the hard drive of all disc-based games, which often run 30 to 50 GB in size. This allows the system to run games more efficiently with shorter load times, and gamers can play the early stages of a game while the rest of the game downloads in the background. The console can also be set up to download updates while in standby mode.

PS4's Orbis operating system is a modified version of the open source FreeBSD 9 which is similar to Linux, and includes a **NetFront** browser. While similar in appearance to the PS3's XrossMediaBar, the PS4's new **Dynamic Menu** is more visually oriented and much more intuitive. For example, when a game is inserted into the system, the menu places the game's icon to the front of the list for easier access. Returning features include the PlayStation Store and **PlayStation Plus** subscription service (now required for online gaming). In 2014 Sony introduced a **cloud gaming** service called **PlayStation Now** where players can pay to download and play various PS3 games on PS4.

Social interaction and interconnectivity are also priorities for the system. In addition to allowing players to stream out gameplay online, its **"Share Play"** functionality allows PlayStation Plus members to invite other members to play their games remotely or join them in multiplayer games for 60 minute sessions—whether the remote members own a copy of the game or not (SIEE Ltd., 2017). While not a widely used feature on the PS3, Sony president **Shuhei Yoshida** mandated all PS4 "to offer **'Remote Play'** on the PS Vita—that is, allow for PS4 games to be played on the Vita via a live video stream" (Rose, 2013, para. 2). This provides Vita owners with a feature similar to Off-TV Play on Wii U.

FIGURE 15.10 PS4 newspaper advertisement (2013) sponsoring the UEFA (soccer league).

DID YOU KNOW?

PS4 was the first console with **built-in game broadcasting**, allowing gamers to broadcast their own gameplay or watch live gameplay from others on platforms such as **Twitch** and **Ustream** (Guinness World Records, 2015, p. 179).

Beyond the typical peripherals such as alternative controllers, steering wheels, headsets, and charging docks—the two most innovative accessories for PlayStation 4 include the **PlayStation Camera** and **PlayStation VR**. The PlayStation Camera looks more like the Microsoft Kinect than a successor to the PlayStation Eye on PS3. The optional motion-sensing camera includes two 1280 × 800 pixel lenses with an 85-degree field of view, which can precisely judge depth of space, sense the colors of the DualShock 4's light bar and **PlayStation Move** motion controller, as well as allowing users to login to their PS4 using face recognition technology (Sony Computer Entertainment Inc., 2013, para. 7). The camera also includes a four-channel microphone array which can be used for voice commands in certain games and hands-free navigation on the Dynamic Menu.

Formerly named "Project Morpheus" after *The Matrix* movie character, Sony joined the virtual reality movement with the PlayStation VR which launched on October 13, 2016. For the introductory price of $399, the basic package included a VR Headset, Processor Unit, stereo headphones, and five required cables. The "PlayStation VR can handle 1080p games on its 920 × RGB × 1080 **OLED [organic light-emitting diode]** display at either 90 Hz (meaning that the image refreshes itself 90 times per second) or at 120 Hz depending on the VR game or application" (Pino, 2017, p. 4).

It is important to note that the PlayStation Camera is also necessary for the unit to play VR games—and while it is compatible with the DualShock 4, most PlayStation VR owners will likely desire a pair of PlayStation Move controllers for a more immersive experience. Recognizing this, Sony released a bundle with these accessories for $499, which was still the most affordable VR system of its time. Game development and early sales for the PlayStation VR have been slow. While the PS4 sold more than a million units in its first day, the PSVR took approximately 6 months to reach a million sold.

Other major releases by Sony before the end of 2016 included the 40% smaller **PS4 Slim** which debuted on September 15, and the larger **PlayStation 4 Pro** that launched worldwide on November 10. The PS4 Slim retained most of the original system's features minus the optical audio output. Among other improvements, the PS4 Pro (codenamed "Neo") can output **4K** resolution (3840 × 2160p) on compatible displays and includes a more powerful **911 MHz** GPU capable of **4.2 TFLOPS** (Porter, 2017).

■ CONSOLE COMPARISON: PLAYSTATION 4 VERSUS WII U

As far as raw power goes, there is little to discuss between the PlayStation 4 and Wii U with the PS4's 8-Core AMD x86-64 Jaguar CPU (Table 15.5) being leagues above the Wii U's Tri-Core Espresso chip. Sony's AMD GPU (codenamed "**Pitcairn**") is more than 30% faster at **800 MHz**, can process more than three times as many shaders, and can perform **1.84 TFLOPS** versus

TABLE 15.5 PlayStation 4 Tech Specs

Manufacturer:	Sony Computer Entertainment and Foxconn
Launch Price:	$399.99
Release Date:	11/15/13 (NA), 11/29/13 (JP), 11/22/14 (EU)
Format:	Blu-ray Disc (up to 50 GB) and DVD
Processors:	8-Core AMD x86-64 "Jaguar" CPU (1.6 GHz)
	AMD Radeon Graphics Core Next (800 MHz) with 1152 shaders
Performance:	Up to 1080p and 1.84 TFLOPS
Memory:	8 GB GDDR5 + 256 MB DDR3 RAM and 500 GB hard drive
Sound:	7.1 Linear PCM and Bitstream (Dolby+DTS) with HDMI+Optical

just 352 GFLOPS on the Wii U. While neither system can play audio CDs, only the PS4 doubles as a DVD and Blu-ray player. Sony's system also features **HDR10 high-dynamic-range color**, four times the amount of RAM, larger internal storage with its **500 GB** hard drive, and more audio output options.

While it isn't a technical powerhouse like the PlayStation 4, the Wii U does have a few advantages, including free online play, backward compatibility with all Wii games, in addition to being a lot more energy efficient. On the other hand, Wii U games are **region-locked**, meaning that NTSC consoles cannot play PAL games and vice versa like the PS4. Another disadvantage is that the Wii U does not support cloud storage. Lastly, in what is basically a draw, the PS4 was built with a user-replaceable, non-proprietary SATA hard drive but does not support external USB storage like the Wii U.

HEAD-TO-HEAD

To compare the performance between PS4 and Wii U games, check out these titles released on both systems: *Assassin's Creed IV, Call of Duty: Ghosts, Child of Light, LEGO City Undercover, The Amazing Spider-Man 2*, and *Watchdogs*.

■ KEY PLAYSTATION 4 TITLES

Thanks to its support of indie and digital-only titles, well over 1000 games, including hundreds of exclusive titles were available for the PS4 by early 2017. Sony's consoles have always had an excellent number of elite titles and the PlayStation 4 is no exception. Some of the best early retail releases included *Bloodborne* by *Dark Souls* developer FromSoftware, *inFAMOUS: Second Son* by Sucker Punch, and Supermassive Games' *Until Dawn*. Console exclusives continued to roll out each year, such as Capcom's *Street Fighter V*, Insomniac's reboot of *Ratchet & Clank*, and SCE Japan Studio's long-awaited *The Last Guardian*—each released in 2016.

As if the system didn't already encompass enough must-have Sony console exclusives, 2017 saw the releases of *Gravity Rush 2, NieR: Automata* (also released on PC), *Nioh, Horizon: Zero Dawn, Yakuza 0*, and *Persona 5* (also on PS3) (see Figure 15.11)—just to name a handful of titles introduced that year. Similar to what began as a common practice on the PS3, the PS4 quickly became notorious for releasing updates of last generation titles such as *God of War III Remastered*, Naughty Dog's *The Last of Us Remastered*, and *Uncharted: The Nathan Drake Collection*.

Naughty Dog continued to release new hits in the *Uncharted* series with *Uncharted 4: A Thief's End* and *Uncharted: The Lost Legacy*. The company is also working on a sequel for *The Last of Us* at the time of this publication. Other key titles include a new *God of War* game and *Ni No Kuni II: Revenant Kingdom*, Hideo Kojima's *Death Stranding, Final Fantasy VII Remake*, along with David Cage and Quantic Dream's *Detroit: Become Human*.

FIGURE 15.11 Box art to five top PS4 titles: (a) *The Witcher 3: Wild Hunt*,(b) *Metal Gear Solid V: The Phantom Pain*, (c) *Uncharted 4: A Thief's End*, (d) *Persona 5*, and (e)*Horizon: Zero Dawn*.

(a) (b) (c) (d) (e)

PRO FILE

MARK CERNY

KEY FACTS:

Lead architect and producer of PS4 and PlayStation Vita

Began career in video games at age 17 with Atari in 1982

PRO FILE

HISTORY:

- Born: August 24, 1964 - Same birthday as Hideo Kojima (who was born just one year earlier)

CAREER HIGHLIGHTS:

- Programmer and Designer for Major Havoc, Marble Madness, California Games, and more (1983-1991)
- Producer for Sonic the Hedgehog 2 (1992)
- Programmer and Designer for Crash 'n Burn (1993) and Total Eclipse (1994) on 3DO and Disruptor (PS1)
- Executive Producer and more for Crash Bandicoot and Spyro the Dragon games on PS1 (1996-2000)
- Also contribued to Jak and Ratchet & Clank series (2001-2007), Resistance series (2006-08), Uncharted: Drake's Fortune (2007), God of War III (2010), Killzone 3 (2011), Knack (2013), The Last Guardian (2016), Knack 2 (2017), and Death Stranding

RECOGNITION:

- IGDA Lifetime Achievement Award in 2004
- Inducted into the Academy of Interactive Arts & Sciences' Hall of Fame in 2010

HANDHELD SNAPSHOT: PLAYSTATION VITA

The PlayStation Vita (Figure 15.12) launched in Japan on December 11, 2011 and on February 22, 2012 in many other regions. See Table 15.6 for specs. The standard Wi-Fi model cost $249 and an **AT&T** network 3G/Wi-Fi model was available for $299.

The Vita abandoned UMDs (from PSP) in favor of **PS Vita Cards**, which are more similar to the game cards on Nintendo's handhelds. Titles can also be downloaded from the PlayStation Network. The original model featured a rear touchpad, plus a 5-inch OLED touchscreen (which was replaced with a cheaper LCD screen on the **PS Vita 2000** model in 2014).

Despite a strong launch and more than 1000 titles available, Sony has sold just over 15 million Vita units as of spring 2017 (VGChartz, 2017). A large portion of Vita's best games have simply been updates or ports of games available on other systems; however, the system is also capable of streaming almost every PS4 game via Remote Play. See Figure 15.13 for some top picks.

FIGURE 15.12 PlayStation Vita.

TABLE 15.6 PlayStation VitaTech Specs

Format:	PS Vita Card/3.7 V 2210mAh lithium-ion battery (3–5 h)
Processors:	Quad-core ARM Cortex-A9 and Power VR SGX543MP4+ GPU
Performance:	17 million colors, 444 MHz CPU, 166 MHz GPU, 6.4 GFLOPS
Memory:	512 MB system RAM and 128 MB VRAM
Resolution:	960 × 544 qHD/OLED touchscreen (5" diagonal)
Sound:	Built-in stereo speakers and microphone/3.5 mm headphones jack

FIGURE 15.13 Box art to five top PlayStation Vita games: (a) *Gravity Rush*, (b) *LittleBigPlanet PS Vita*, (c) *WipEout 2048*, (d) *Tearaway*, and (e) *Zero Escape: Zero Time Dilemma*.

(a) (b) (c) (d) (e)

■ XBOX ONE

Microsoft's next system was often referred to by gamers and journalists as the "Xbox 720" prior to its release—however, its actual codename was "**Durango**" (Dutton, 2012, p. 1). Following its official title, **Xbox One** (Figure 15.14), the system underwent public scrutiny after the 2013 **E3 conference** where many of Microsoft's announcements left attendants unhappy. Among those announcements, the new console would require the (once optional) Kinect sensor to function and would need to connect to the Internet daily as part of a new **digital rights management (DRM)** system. The DRM scheme would bind each purchased game to the user's Xbox Live account, severely limiting the sharing or sale of preowned games—essentially eradicating the concept of renting physical titles (Bramwell, 2013, para. 5).

Microsoft quickly removed these restrictions after the public backlash from its E3 announcements and shortly thereafter, president of Microsoft's Interactive Entertainment Business **Don Mattrick** announced he would be leaving Microsoft to become CEO of social game developer **Zynga**. Although no longer required, the Kinect remained bundled with the Xbox One at launch, resulting in a $499 price tag when the console debuted in North America and parts of Europe on November 22, 2013. The system would not reach Japan and many other countries until September 2014. Despite the negative press, Microsoft saw its biggest Xbox launch, selling more than 1 million units during the console's first 24 hours on store shelves (Xbox Wire, 2013, p. 1). See Table 15.7 for launch titles.

TABLE 15.7 Xbox One U.S. Launch Titles

- Angry Birds Star Wars
- Assassin's Creed IV: Black Flag
- Battlefield 4
- Call of Duty: Ghosts
- Crimson Dragon
- Dead Rising 3
- FIFA 14
- Fighter Within
- Forza Motorsport 5 (Figure 15.15a)
- Just Dance 2014
- Killer Instinct (Figure 15.15b)
- Lego Marvel Super Heroes
- LocoCycle
- Madden NFL 25
- NBA 2K14
- NBA Live 14
- Need for Speed: Rivals
- Powerstar Golf
- Ryse: Son of Rome
- Skylanders: Swap Force
- Zoo Tycoon
- Zumba Fitness: World Party

The original bundle consisted of an Xbox One console with 500 GB hard drive, Kinect peripheral (shown in Figure 15.16), wireless controller with two AA batteries, Xbox One **Chat Headset** with adapter, HDMI and power cables, and a free 14-day trial of **Xbox Live Gold**. The design of the new console, **Kinect 2.0**, and the controller was led by **Carl Ledbetter**. The system's bulky design (much larger than the original PS4) was stylized to complement existing home entertainment products.

FIGURE 15.14 Xbox One console with original controller.

FIGURE 15.15 Screens of Xbox One launch titles (a) *Forza Motorsport 5* and (b) *Killer Instinct*.

(a)

(b)

The casing featured a two-tone color scheme (referred to by Ledbetter as "liquid black") with each half measuring 16 × 9, consistent to the shape of a modern television screen. A large air vent was implemented to help the system run more quietly but unlike the Xbox 360, the original Xbox One had to sit horizontally for optimal airflow and venting (Goldfarb, 2013, p. 1). On the plus side, the system was programmed to monitor its internal temperature and could increase fan speed or cycle down its power usage to prevent overheating (Reisinger, 2013, para. 3).

Ledbetter's team made more than 40 improvements to the controller, such as the micro-texture around the sides of the thumbsticks, refined d-pad, finish of the

FIGURE 15.16 Xbox One online ad (2013) featuring Kinect, console, and controller.

buttons, and streamlined battery pack. Even the triggers were given the royal treatment, featuring separate rumble motors called **"impulse triggers"** that can be programmed to vibrate separately or together depending on the situation. Another unique and consistent feature on all three major devices includes "the 'white, magical' backlit Xbox logo on the console, Kinect and controller that knows to dim when the room is dark and shine brightly when it's not" (Warnick, 2014). Like Sony (and unknown to either of them at the time), Microsoft chose AMD to design its custom APU based on its "Jaguar" architecture. Its eight-core CPU was clocked at 1.75 GHz, complimented by an 853 MHz Radeon **"Bonaire"** GPU with 768 shaders, providing a peak theoretical power of 1.31 TFLOPS.

DID YOU KNOW?

For the Xbox One hardware, "Ledbetter and his colleagues on the Xbox industrial design team sketched and then 3D-printed … more than 75 iterations of the console, 100 of Kinect, and more than 200 of the controller" and "more than 1,000 pairs of hands" went into testing the various versions of the controller" (Warnick, 2014).

The original Xbox One used **DirectX** 11.2 for its **Application Programming Interface (API)**, along with three operating systems (including Windows) to run applications and games concurrently. This unique ability set the system apart from other consoles and is most apparent when using the system's split-screen multitasking functions with different applications. The console's **Snap** feature, which it borrowed from Windows 8, was similar to a more interactive version of **picture-in-picture (PiP)**. Snap provides the "ability to produce numerous visual 'panes,' which are full 1080p layers generated independently and displayed one on top of the other. These panes … allow a user to play full-fledged Xbox games while also seeing their fantasy football app or Skype chat updating in an overlaid Windows pane" (Sakr, 2013, para. 3).

Microsoft's prelaunch slogan for the Xbox One was "All for one. Input one." Subsequent advertisements have also emphasized the console's focus on being an all-in-one entertainment system that can be integrated with television programming, streaming, and social media applications. The console featured its own program guide called **OneGuide** and like the PlayStation Camera, players could use Kinect 2.0's improved motion tracking and voice recognition to navigate the system's **Dashboard** interface using hand gestures and voice commands. Also like PS4, Xbox One featured a greater emphasis on cloud computing, live streaming, and sharing screenshots or video clips of gameplay with the **GameDVR** app.

Similar to PS4's Dynamic Menu, the original "Metro" style UI for the Xbox One displayed recently used programs and games upon boot up. However, the interface was clearly made to utilize Kinect's voice commands, making navigation of the (often hidden) menus with the controller or motion gestures somewhat cumbersome (Rivington, 2017, p. 1). Microsoft completely overhauled the UI with an all-new user interface called the **"New Xbox One Experience"** as a system update on November 12, 2015.

The updated, Windows 10-based firmware added a plethora of new features, including a new layout with more vertical navigation, a Snap overlay menu that can be quickly accessed by double clicking the Xbox button, and the **"Play Anywhere"** ability to stream Xbox One console games remotely to any PC or other device running Windows 10 (Veloria, 2015). The new UI also added backward compatibility with a number of Xbox 360 games where users can insert an Xbox 360 disc into the Xbox One, which then authenticates the game and downloads a digital copy to the system's hard drive. Another new feature of the New Xbox One Experience is greater social integration with the new **Xbox App** (formerly Xbox One **Smartglass**), such as its **"Clubs"** area where users can chat and play with other gamers in a public, private, or hidden (invitation-only) setting.

While the new UI made many improvements and additions to the console, it also removed hand gesture control. According to Director of Program Management for Xbox **Mike Ybarra**, the feature was removed because hardly anyone used it (Graham, 2015, para. 5).

In its place, a new voice assistant named **Cortana** was added in 2016. Similar to Apple's **Siri** and Amazon's **Alexa**, Cortana added improved voice command functionality and better natural language recognition. The Dashboard was updated further on March 29, 2017, featuring "a new Home screen, improved Guide menu, the **Beam** streaming option, enhanced multi-tasking and deeper Cortana integration" (Hall, 2017, para. 1).

Among the many traditional accessories for the system, perhaps the most unique addition was the $150 **Elite controller** released in October 2015. The controller added "four interchangeable paddles around back [to allow gamers to keep both thumbs on the thumbsticks at all times], **Hair Trigger Locks** for precise control in shooters, remappable buttons, and completely swappable components" (Welch, 2015, para. 1). In addition to releasing retail configurations of the Xbox One without the Kinect sensor, the **Xbox One Elite** (bundled with an Elite controller and a 1 TB solid-state hybrid drive) was released in November 2015 for $499.

This was followed by the 40% smaller, slightly faster **Xbox One S** in August 2016, which like the PS4 Pro, supports 4K video resolution and brings the console up to par with the original PS4's HDR10 high-dynamic-range color. The new model contains an internal power supply and can be positioned vertically with a stand—however, the updated system requires a USB adapter to attach the Kinect. Further enhancements to the S model include **Ultra HD Blu-ray** and **Bluetooth 4.0** support. Codenamed "**Project Scorpio**," a third major iteration released in late 2017 was **Xbox One X** with even faster processors and 50% more memory and bandwidth than the Xbox One S.

■ CONSOLE COMPARISON: XBOX ONE VERSUS PLAYSTATION 4

For those not interested in Kinect or PlayStation Camera, the PS4 had the advantage at launch of being $100 cheaper and more powerful overall. Both systems contain an **x86-64 APU** by AMD with CPUs that are practically identical, other than Xbox One being clocked at **1.75 GHz** (Table 15.8) versus 1.6 GHz on the PS4. Both GPUs are based on Graphics Core Next (GCN) architecture with the Xbox One's **853 MHz** GPU clocking slightly higher than the 800 MHz GPU in the PS4. Otherwise, Xbox One's GPU contains just **12 compute units** (768 shaders) and a peak performance of **1.31 TFLOPS** versus the PS4's 18 compute units (1,152 shaders) and 1.84 TFLOPS of power—a 50% advantage.

TABLE 15.8 Xbox One Tech Specs

Manufacturer:	Flextronics & Foxconn
Launch Price:	$499.99
Release Date:	11/22/13 (NA & EU), 09/04/14 (JP)
Format:	Blu-ray Disc (up to 50 GB), DVD, and Audio CDs
Processors:	8-Core AMD Custom Microsoft CPU (1.75 GHz) AMD Radeon "Bonaire" GPU (853 MHz) with 768 shaders
Performance:	Up to 1080p and 1.31 TFLOPS
Memory:	8 GB DDR3 + 32 MB eSRAM and 500 GB hard drive
Sound:	7.1 Linear PCM and Bitstream (Dolby+DTS) with HDMI+Optical

That advantage is expanded even further with the PS4's 5500 MHz GDDR5 RAM, which is twice as fast as the **2133 MHz DDR3 RAM** found in Xbox One. "This leads to a massive bandwidth advantage in favor of the PS4. The PS4's CPU and GPU have 176 GB/s of bandwidth to system RAM, while the Xbox One has just **68.3 GB/s**. In Microsoft's favor, the Xbox One has **32 MB** of super-fast embedded SRAM (about 102 GB/sec in each direction, for a total of **204 GB/sec** of bandwidth)" (Lendino, 2015, para. 8). When used appropriately, this extra RAM can narrow the speed difference; however, cross-platform games have typically run at higher resolutions or fps on the PS4.

In other comparisons, both consoles can download updates while in standby mode and all games for each system require installation—a process that has been shown to take longer on Xbox One (Rivington, 2017, p. 2). Each console emphasizes social media, sharing clips

and screenshots, and can be connected to tablets and phones. While the PS4 can export the last 15 minutes of gameplay with its Share function, the Xbox One can only record the most recent 5 minutes of gameplay but can export the last 30 seconds of gameplay on the fly with the Kinect voice command, "Xbox, record that" (Grubb, 2013, para. 3–7).

Microsoft's 2015 firmware update provided some notable perks for the Xbox One, including a growing list of backward compatibility with Xbox 360 games. "Sony, on the other hand, relies on its cloud gaming platform PlayStation Now to deliver playable PS3 games, but that is a rental or subscription service that requires additional payment" (Henderson, 2015, para. 14). Furthermore, the Xbox One's ability to stream games to Windows 10 devices is arguably more desirable than PS4's Remote Play integration with PlayStation Vita. Both systems charge for online gaming, with an annual subscription to Xbox Live Gold or PlayStation Plus running $59.99 in 2017.

HEAD-TO-HEAD

There were a number of games that were released on both the Xbox One and PS4. Compare the gameplay and graphics to each system's version of *Battlefield 1, Grand Theft Auto V, Pro Evolution Soccer 2017, Resident Evil 7: Biohazard,* and *Titanfall 2*.

Each system features improved and more ergonomic controllers but only Sony's features a touchpad, speaker, and motion controls. While a rechargeable battery pack can be purchased, the Xbox One still requires two AA batteries out of the box, compared to the built-in rechargeable lithium ion battery pack in the PS4 controller. The PS4 controller is easier to charge with its mini USB cable which can be charged while gaming, whereas the batteries tend to last around five times longer in the Xbox One controller.

In line with its greater emphasis on multitasking, the Xbox One is the only console reviewed in this chapter that can play audio CDs. Both systems eventually supported MP3 format and **DLNA (Digital Living Network Alliance)**, which allows users to stream media from a computer to their home console. While the original Xbox One lacked the Bluetooth and HDR10 high-dynamic-range color of the PS4, Microsoft added those features to the Xbox One S—which brings up an important point. With the growing trend of firmware updates and the release of more powerful iterations of existing systems (such as the Xbox One S, PS4 Pro, and Xbox One X), comparing consoles is becoming a constantly evolving process. Table 15.9 illustrates some of the key differences in performance among the many models of current-generation hardware introduced by Sony and Microsoft this generation.

FIGURE 15.17 Box art to five Xbox One classics: (a) *: Forza Horizon 3,* (b) *Fallout 4,* (c) *Ori and the Blind Forest: Definitive Edition,* (d) *Overwatch: Origins Edition*, and (e) *Rise of the Tomb Raider.*

(a) (b) (c) (d) (e)

TABLE 15.9 Xbox One and PS4 Console Versions Compared (Walton, 2017)

	PS4	Xbox One	Xbox One S	PS4 Pro	Xbox One X
CPU	8 cores @ 1.6 GHz	8 cores @ 1.75 GHz	8 cores @ 1.75 GHz	8 cores @ 2.1 GHz	8 cores @ 2.3 GHz
GPU	18 AMD GCN CUs @ 800 Mhz	12 GCN compute units @ 853 MHz	12 GCN compute units @ 914 MHz	36 AMD GCN CUs @ 911 Mhz	40 custom compute units @ 1172 MHz
Memory	8 GB GDDR5 and 256 MB DDR3	8 GB DDR3 and 32 MB ESRAM	8 GB DDR3 and 32 MB ESRAM	8 GB GDDR5 and 1 GB DDR3	12 GB GDDR5
Bandwidth	176 GB/s	68 and 204 GB/s	68 and 219 GB/s	218 GB/s	326 GB/s
Hard Drive	500 GB	1 TB/500 GB	1 TB/500 GB	1 TB	1 TB
Optical Drive	Blu-ray	Blu-ray	4K UHD and Blu-ray	Blu-ray	4 K UHD and Blu-ray

■ KEY XBOX ONE TITLES

More than 1000 games have been released for the Xbox One, including a few dozen exclusive titles. New Xbox-only titles include the hilariously fun *Sunset Overdrive*, puzzle platformer *Fru*, massive *Rare Replay* compilation, and **Remedy Entertainment**'s follow-up to *Alan Wake*, *Quantum Break* (also on PC). Returning first-party exclusives include *Gears of War 4* (now developed by Canadian studio **The Coalition**), several games from the *Forza* series, and multiple *Halo* titles including *Halo: Spartan Assault, Halo Wars 2*, and *Halo: The Master Chief Collection* to name a few.

Rise of the Tomb Raider (shown in Figure 15.17) was released exclusively for Microsoft systems and did not reach the PS4 for nearly a year later. Exclusives, however, have been an issue for the system. *Halo: The Master Chief Collection*, "which comprises *Halos 1–4* remastered with updated single and multiplayer portions of the FPS classics, has been plagued by match-making issues since release, leading developers **343 Industries** to offer huge chunks of upcoming DLC (including the entirety of *Halo: ODST*) as free downloads to placate disgruntled owners" (Rivington, 2017, para. 17). The game was so large that it took up nearly all 45 GB of its Blu-ray disc and required a 20 GB **day one patch** to access its online multiplayer mode. Other highly anticipated exclusives such as *Phantom Dust, Scalebound*, and *Fable Legends* have been outright canceled by Microsoft.

On the bright side, Microsoft now owns the rights to *Minecraft* after purchasing publisher/developer **Mojang** in late 2014. Notable cross-platform games not already mentioned in this chapter include **Playdead**'s follow-up to Limbo called *Inside*, *Dark Souls III*, *Rocket League*, *Dishonored 2*, *Dragon Age: Inquisition*, *Batman: Arkham Knight*, *Mortal Kombat X*, *Far Cry 4*, plus first-person shooters *Battlefield 1*, *Doom*, *Overwatch*, and *Call of Duty: Infinite Warefare*.

HYBRID SNAPSHOT: NINTENDO SWITCH

Codenamed "**NX**," the **Nintendo Switch** (Figure 15.18) was released worldwide on March 3, 2017 for $299. See Table 15.10 for launch titles. The Switch is a hybrid unit that doubles as a portable handheld system, as well as a home console when inserted into its docking station and connected to a TV. Its unique detachable **Joy-Con** controllers allow for multiplayer gaming both at home and on the go. According to **SuperData Research**, the Switch sold over 1.5 million consoles in its first two weeks, along with the strong **attach rate** of an estimated 89% of Switch owners purchasing *The Legend of Zelda: Breath of the Wild* with the console (Dring, 2017, para. 1–4).

FIGURE 15.18 Nintendo Switch.

TABLE 15.10 Nintendo Switch U.S. Launch Titles (*digital-only)

• 1-2-Switch	• Shovel Knight : Specter of Torment*
• Fast RMX*	• Shovel Knight : Treasure Trove*
• I Am Setsuna*	• Skylanders : Imaginators
• Just Dance 2017	• Snipperclips
• Legend of Zelda: Breath of the Wild	• Super Bomberman R

With flash storage becoming larger and more affordable, Nintendo was able to abandon optical media in favor of **flash ROM cartridges** as its main form of physical game media. Like its previous two consoles, the Nintendo Switch focuses on a new way of playing video games, rather than the raw power of Microsoft and Sony's systems. Refer to Table 15.11 to compare specs.

TABLE 15.11 Nintendo Switch Tech Specs

Format:	Flash ROM cartridge/4310 mAh Li-ion battery (2.5–6 h)
Processors:	Nvidia Custom Tegra X1 with four ARM Cortex A57 CPU cores and four ARM Cortex A53 CPU cores (1.020 GHz)
	GM20B Maxwell CUDA GPU with 256 cores (307.2–768 MHz)
Performance:	Estimated more than 1 teraflop of (Takashi, 2016, para. 11)
Memory:	4 GB LPDDR4 RAM / 32 GB internal storage, expandable to 2 TB
Resolution:	1920 × 1080p docked and 1280 × 720p on 6.2" LCD screen
Sound:	5.1ch Linear PCM output/stereo speakers, with 3.5 mm jack

■ MARKET SUMMARY

The market saw many changes during this generation of video games. Console updates (i.e., PS4 Pro, Xbox One S and X) have become even more significant and are extending the life cycles of consoles today. Along with more digital games than ever being available for download, manufacturing costs of physical games are being cut by using game cases that use less plastic and most companies have discontinued including paper instruction manuals. China became a new market for video game systems when it lifted its 14-year-old console ban in 2014 and eliminated all sales restrictions in 2015.

After suffering one of its worst financial losses in 2014, Nintendo had to face the mobile landscape as a possible option for its beloved **intellectual properties (IPs)**. Following much hesitation by Nintendo president **Satoru Iwata**, Nintendo finally announced an alliance with Japanese mobile provider **DeNA** in March 2015 (Peckham, 2015, para. 3). The first titles to be launched under the new partnership were *Miitomo* and *Super Mario Run* in 2016; however, a year before their release Iwata passed away from a bile duct growth on July 11, 2015 (Plunkett, 2015, para. 1). He was succeeded by **Tatsumi Kimishima**.

As for the Wii U, perhaps one of Nintendo's biggest mistakes was with its marketing. "When the Wii U was originally announced, [Nintendo] put a lot of emphasis on the tablet controller, but near nothing was mentioned about the console itself" (Gittins, 2015, para. 4). It also didn't help that the Wii U console looked just like a slightly larger, rounder Wii. Since the original Wii was known for its many accessories, many consumers viewed the Wii U Gamepad as an accessory for the original Wii and were not aware that the Wii U was a completely new console. Third-party support eventually died out and Nintendo struggled to release a substantial number of quality first-party games on a consistent basis. After just 4 years on the market, the Wii U became overshadowed by Nintendo's marketing of the Switch, and the console was officially discontinued on January 31, 2017 (Frank, 2017, para. 1).

Sony saw a major shift in its console development when president of Sony's Worldwide Studios for SIE **Shuhei Yoshida** approved American software designer Mark Cerny as the lead architect for both the PlayStation Vita and PS4. Approaching the new hardware from a game developer's perspective was a way of correcting some of the difficulties the company faced with the PS3. The PS4 got off to a strong start before it was even released, thanks to Microsoft's blunders at E3 2013 which Sony was able to capitalize on. Sony received a standing ovation at their E3 conference after confirming "the PlayStation 4 would fully support used games, allow for easy lending and would have absolutely zero online requirements to play single player games" (Tassi, 2013, para. 7).

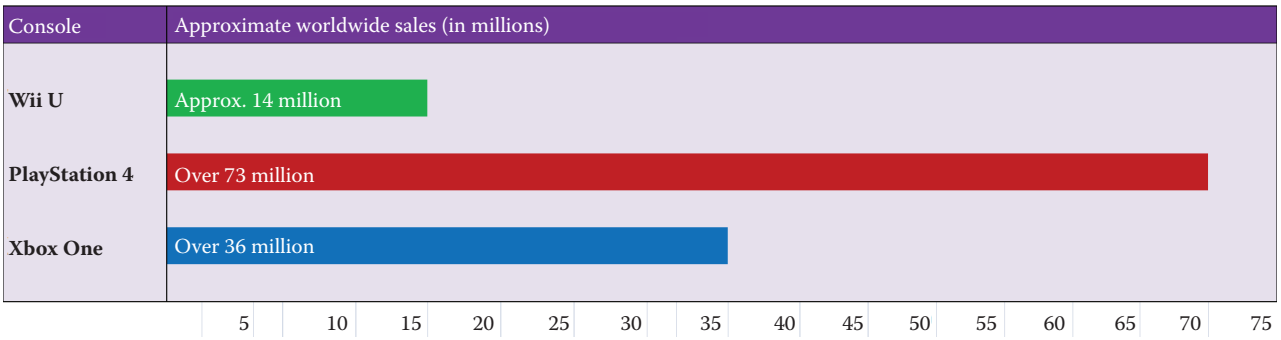
The PS4's $399 launch price was $100 less than an Xbox One and the system took off as the forerunner for the modern console generation. Just two years after its launch, Sony announced that the PlayStation 4 had sold more than 30.2 million units, making it the fastest-selling PlayStation console in that time period (Smith, 2015, para. 1). The console would maintain its lead in the years that followed, and by 2017 Sony had sold an estimated 53.4 million consoles (Sony Interactive Entertainment, 2017, p. 1).

Microsoft recovered from E3 2013 by retracting most of the features that led to its bad press, such as requiring the Kinect accessory, needing a daily online connection to play offline games, and restricting the usage of preowned games. The system's debut was the most successful launch for an Xbox console, although sales in Japan continued to remain poor. "The Xbox One sold a total of 23,562 units during its launch week in Japan [while] PlayStation 4, in comparison, opened to 309,000 sales, and Wii U to 308,000" (Romano, 2014, p. 1). Even the Xbox 360 fared better with 62,000 units sold in its first week when it debuted in Japan back in 2005.

Since around 2015, Microsoft essentially stopped releasing sales figures for the Xbox One, although external sources such as SuperData Research, VGChartz, and other resources have helped paint a picture of how the console has sold over the years. A 2017 report from SuperData Research claimed that the Xbox One reached 26 million units sold and Microsoft stated that December 2016 was the company's "biggest month ever for Xbox One sales in the U.S." which was "the top-selling console over the second half of 2016, following the announcement of Xbox One S at E3" (Makuch, 2017, para. 3).

In one of the most widely separated sales comparisons (featuring such clear first, second, and third place sales figures among systems), Microsoft found itself in a solid second place—selling more than twice as many Xbox Ones to Wii Us, but just around half of the number of PS4s as shown in Figure 15.19. For handhelds, Nintendo's 3DS line has sold more than 70 million units—four times the number of PS Vitas, which have sold approximately 15.5 million units. Early sales of the Nintendo Switch have been quite strong, reaching close to the total number of Wii U units sold in its first year alone.

FIGURE 15.19 Modern generation console sales graph (as of early 2018).



■ MODERN GAMING BREAKTHROUGHS AND TRENDS

There were many breakthroughs and trends that defined the modern era of video games. Here is a list of the top 10 features that defined the generation:

1. Console upgrades to extend the life cycle of existing game systems
2. 4K display resolutions (up to 3840 × 2160p) via HDMI 2.0
3. Stronger GPUs (with up to 4.2 TFLOPS on PS4 Pro and 6.0 on Xbox One X)
4. Greater RAM (up to 8 GB on standard systems and 12 GB on Xbox One X)
5. Deeper integration with more apps and electronic devices
6. More intuitive, voice-controlled user interfaces
7. Emphasis on recording and sharing videos or pictures on social media
8. Augmented and virtual reality
9. Cloud-based gaming
10. Hybrid handheld/console gaming with Nintendo Switch

■ FINAL THOUGHTS

When the Wii U released in 2012, many journalists deemed it the start of the next generation. The PlayStation 4 and Xbox One joined the market in the following year, and the two handhelds, Nintendo 3DS and PlayStation Vita, were retrospectively added to what is often called the "eighth generation." In addition to revised models of the handheld units, Sony and Microsoft released upgraded, 4K versions of their home systems in 2016 with the PS4 Pro and Xbox One S and X. These were followed by Nintendo's hybrid Switch console in 2017, at which point many historians began to argue what generation it belonged in or whether the market had reached a point where it was no longer appropriate to categorize game systems into generations.

There are even some historians who believe the concept of a game console may one day become obsolete. Since game consoles are essentially computers and vice versa, along with the way convergence is going, it may only be a matter of time when the two technologies become virtually indistinguishable. Regardless of how they are labeled or delivered, one thing is for certain: video games are big business and they're here to stay. For this edition of *The Video Games Textbook:* Game Over!

Thanks for reading!
Dr. W

■ ACTIVITY: 15 MINUTES OF FAME

Twitch and Ustream have become major platforms for live streaming of gameplay including complete playthroughs of video game campaigns, multiplayer tournaments, eSports, and other webcasts. YouTube also allows live streaming and remains a popular platform for posting videos of game reviews, tutorials, and similar videos.

GUIDELINES

Create an account with one of the three major online video services listed above. Obtain a PlayStation 4 or Xbox One console and create your own live stream or 5- to-15-minute prerecorded video production of a video game review or other type of video using video game footage via the PS4 and Xbox One's sharing capabilities. A headset should be used to include a voiced commentary to accompany your video footage. Downloaded video game demos may be used for this exercise.

QUESTIONS

1. What was the purpose of your video; what game did you select and why?
2. Describe the process of setting up an online account and any challenges you faced in setting up the game console and streaming and/or capturing video footage.
3. How did the production go? Explain the pros and cons of the experience.
4. Has this experience opened new doors for how you will use video game technology? Elaborate on your answer.
5. Where do you see this technology going in the future?

■ CHAPTER 15 QUIZ

1. What is helping keep most arcade venues afloat in the United States?
   a. The rise of casual games
   b. Video redemption or "videmption" games
   c. Food and beverage service
   d. All of the above

2. Nintendo's Wii U was originally codenamed:
   a. Project Café
   b. Orbis
   c. Durango
   d. NX

3. Which of the following was *not* a key feature of the Nintendo Wii U GamePad?
   a. Asymmetrical, multiplayer gaming
   b. Ability to stream 3DS games
   c. Off-TV Play
   d. NFC (near-field communication) reader/writer

4. This handheld system featured an autostereoscopic upper screen that could display stereoscopic 3D effects without 3D glasses:
   a. Nintendo 2DS
   b. Nintendo 3DS
   c. PlayStation Portable
   d. PlayStation Vita

5. This console's development was fronted by lead architect and producer Mark Cerny:
   a. Wii U
   b. PlayStation 4
   c. Xbox One
   d. Nintendo Switch

6. This gamepad includes a clickable, two-point capacitive touchpad and LED light bar:
   a. Wii U GamePad
   b. DualShock 4
   c. Xbox One controller
   d. Joy-Con

7. The PlayStation 4 function that allows PlayStation Plus members to share gameplay clips or invite other members to play their games remotely:
   a. Snap (PiP)
   b. Play Anywhere
   c. Remote Play
   d. Share Play

8. Which of the following was *not* one of the original plans for the Xbox One announced at the 2013 E3 conference?
   a. Kinect sensor required
   b. Daily Internet connection required
   c. Xbox Live account required
   d. Digital rights management (DRM) restricted pre-owned game usage

9. The design of the Xbox One console, Kinect 2.0, and Xbox One controller was led by:
   a. Don Mattrick
   b. Carl Ledbetter
   c. Mark Cerny
   d. Tetsu Sumii

10. Which was *not* a unique feature of the Xbox One console or controller?
    a. Snap (PiP)
    b. Separate rumble motors called "impulse triggers"
    c. OneGuide and GameDVR apps
    d. Options and Share buttons

11. The "New Xbox One Experience" user interface update added:
    a. a new layout with more vertical navigation and a Snap overlay menu
    b. backward compatibility with a number of Xbox 360 games
    c. "Play Anywhere" to stream Xbox One games to other Windows 10 devices
    d. all of the above

12. Even though more than half of its early titles had been released on other consoles, this system's 34 launch titles were the most ever for a home console:
    a. Wii U
    b. PlayStation 4
    c. Xbox One
    d. Nintendo Switch

13. The first home console with a CPU that utilized OOE (Out of Order Execution):
    a. Wii U
    b. PlayStation 4
    c. Xbox One
    d. Nintendo Switch

14. Like Activision's *Skylanders* series, _____ developed its own series of figurines called "amiibo" to play with certain games:
    a. Microsoft
    b. Nintendo
    c. Sega
    d. Sony

15. Similar to Apple's Siri and Amazon's Alexa, _____ on the Xbox One added improved voice command functionality and better natural language recognition:
    a. Beam
    b. Cortana
    c. Ybarra
    d. None of the above

16. The only console that did not contain a graphics processing unit (GPU) by AMD:
    a. Wii U
    b. PlayStation 4
    c. Xbox One
    d. Nintendo Switch

True or False

17. Except for fighting games, the modern era of arcades implemented the business strategy of *not* porting arcade games to home consoles.

18. To run games more efficiently, the PS4 and Xbox One require mandatory installation to the hard drive of all disc-based games.

19. The PlayStation Camera is required for the PlayStation VR unit to play VR games.

20. The original Xbox One utilized a smaller air vent than the Xbox 360 to help the system run more quietly and to allow the console to sit both horizontally and vertically.

■ FIGURES

FIGURE 15.1 Screenshots of arcade hits (a) *Terminator Salvation* and (b) *Star Wars: Battle Pod.* (*Terminator Salvation* courtesy of Raw Thrills, 2010; and *Star Wars: Battle Pod* courtesy of Bandai Namco Games, 2014.)

FIGURE 15.2 Nintendo's Wii U console with touchscreen-enabled Wii U GamePad. ("Wii U Console and Gamepad transparent background" By Takimata (edited by:Tokyoship) - File:Wii U Console and Gamepad.jpg, CC BY-SA 3.0. Available at https://commons.wikimedia.org/w/index.php?curid=23214469. Retrieved from https://en.wikipedia.org/wiki/Wii_U#/media/File:Wii_U_Console_and_Gamepad.png)

FIGURE 15.3 Wii U print advertisement showing Deluxe set with black hardware (2012). ("Wii U Releases in North America November 18th." Posted by Jason Nason, September 13, 2012. Retrieved from http://www.darkainarts.com/gamers/wp-content/uploads/2012/09/wii_u_8gb.jpg)

FIGURE 15.4 Screens of Wii U launch titles (a) *New Super Mario Bros. U* and (b) *Nintendo Land.*

FIGURE 15.5 Box art to five Wii U hits including from: (a) *Super Mario 3D World,* (b) *Rayman Legends,* (c) *Super Smash Bros. for Wii U,* (d) *Bayonetta 2*, and (e) *Mario Kart 8.* (*Super Mario 3D World* courtesy of Nintendo, 2013; *Rayman* Legends courtesy of Ubisoft Montpellier /Ubisoft, 2013; *Super Smash Bros. for Wii U* courtesy of Bandai Namco Games/Nintendo, 2014; *Bayonetta* 2 courtesy of Platinum Games /Nintendo, 2014; and *Mario Kart 8* courtesy of Nintendo, 2014.)

FIGURE 15.6 Nintendo 3DS. ("A Nintendo 3DS in Aqua Blue, photo taken during the 3DS launch event in NYC." By Evan-Amos - own work, public domain. Available at https://commons.wikimedia.org/w/index.php?curid=14719223. Retrieved from https://en.wikipedia.org/wiki/Nintendo_3DS#/media/File:Nintendo-3DS-AquaOpen.png)

FIGURE 15.7 Five 3DS hits: (a) *Super Mario 3D Land,* (b)*Pokémon Sun,* (c)*The Legend of Zelda: A Link Between Worlds,* (d) *Fire Emblem: Awakening*, and (e)*Metroid: Samus Returns.* (*Super Mario 3D Land* courtesy of Nintendo, 2011; Pokemon Sun courtesy of Game Freak/Nintendo, 2016; *The Legend of Zelda: A Link Between Worlds* courtesy of Nintendo, 2013; *Fire Emblem: Awakening* courtesy of Intelligent Systems/Nintendo, 2013; and *Metroid: Samus Returns* courtesy of Mercury Steam/Nintendo, 2017.)

FIGURE 15.8 Sony PlayStation 4 with DualShock 4 controller. ("The PlayStation 4 (PS4) gaming console made by Sony: Released on 11-15-2013 in North America it is an eighth generation system and competes with the Microsoft Xbox One and the Nintendo Wii U." By Evan-Amos - Media:PS4-Console-wDS4.jpg. Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=37808618. Retrieved from https://en.wikipedia.org/wiki/PlayStation_4#/media/File:PS4-Console-wDS4.png)

FIGURE 15.9 Screenshots from PlayStation 4 launch titles (a) *FIFA 14* and (b) *Resogun.* (*FIFA 14* courtesy of EA Canada/EA Sports, 2013; and *Resogun* courtesy of XDEV & Housemarque/SCEA, 2013.)

FIGURE 15.10 PS4 newspaper advertisement (2013) sponsoring the UEFA (soccer league). ("PS4 headed to Europe this year, according to an advertisement." By Dave Tach, May 24, 2013. Retrieved from http://www.polygon.com/2013/5/24/4362514/ps4-release-date-europe-2013)

FIGURE 15.11 Box art to five top PS4 titles: (a) *The Witcher 3: Wild Hunt,*(b) *Metal Gear Solid V: The Phantom Pain,* (c) *Uncharted 4: A Thief's End,* (d) *Persona 5*, and (e)*Horizon: Zero Dawn.* (*The Witcher 3: Wild Hunt* courtesy of CD Projekt Red Studio/Warner Bros. Interactive Entertainment, 2015; *Metal Gear Solid V: The Phantom Pain* courtesy of Kojima Productions & Moby Dick Studio/Konami, 2015; *Uncharted 4: A Thief's End* courtesy of Naughty Dog/SCEA, 2016;

Persona 5 courtesy of Atlus, 2017; and *Horizon: Zero Dawn* courtesy of Guerrilla/Sony Interactive Entertainment, 2017.)

FIGURE 15.12 PlayStation Vita. ("The PlayStation Vita, a handheld gaming console by Sony released in 2012. The successor to the PlayStation Portable (PSP), the Vita has numerous improvements over the previous system." By Evan-Amos - own work. Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=45662069. Retrieved from https://en.wikipedia.org/wiki/PlayStation_Vita#/media/File:PlayStation-Vita-1101-FL.png)

FIGURE 15.13 Box art to five top PlayStation Vita games: (a) *Gravity Rush,* (b) *LittleBigPlanet PS Vita,* (c) *WipEout 2048,* (d) *Tearaway*, and (e) *Zero Escape: Zero Time Dilemma.* (*Gravity Rush* courtesy of SCE Japan Studio/SCEA, 2012; *LittleBigPlanet PS Vita* courtesy of Tarsier Studios & Double Eleven/SCEA, 2012; *Wipeout 2048* courtesy of Studio Liverpool/SCEA, 2012; *Tearaway* courtesy of Media Molecule/SCEA, 2013; and *Zero Escape: Zero Time Dilemma* courtesy of Chime/Aksys Games, 2016.)

FIGURE 15.14 Xbox One console with original controller. ("The Xbox One console, shown with the controller and the Kinect: Released in 2013 in North America and select markets, it is the third video game console made by Microsoft and succeeds the Xbox 360." By Evan-Amos - own work. Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=31257131. Retrieved from https://en.wikipedia.org/wiki/File:Microsoft-Xbox-One-Console-Set-wKinect.jpg)

FIGURE 15.15 Screens of Xbox One launch titles (a) *Forza Motorsport 5* and (b) *Killer Instinct*. (*Killer Instinct* courtesy of Double Helix Games/Microsoft Game Studios, 2013; and *Forza Motorsport* 5 courtesy of Turn 10/Microsoft Game Studios, 2013.)

FIGURE 15.16 Xbox One online ad (2013) featuring Kinect, console, and controller. ("New Xbox One Ad Shouts: '1080p/60, Adaptive A.I and Exclusive DLCs And More'" By Alex Smith, October 3, 2013. Retrieved from http://www.gamepur.com/news/12288-new-xbox-one-ad-shouts-1080p60-adaptive-ai-and-exclusive-dlcs-and-more.html)

Figure 15.17 Box art to five Xbox One classics: (a) *: Forza Horizon 3,* (b) *Fallout 4,* (c) *Ori and the Blind Forest: Definitive Edition,* (d) *Overwatch: Origins Edition*, and (e) *Rise of the Tomb Raider.* (*Forza Horizon* 3 courtesy of Playground Games/Microsoft Game Studios, 2016; *Fallout 4* courtesy of Bethesda Game Studios/Bethesda Softworks, 2015; *Ori and the Blind Forest: Definitive Edition* courtesy of Moon Studios/Microsoft Game Studios, 2016; *Overwatch: Origins Edition* courtesy of Blizzard Entertainment, 2016; and *Rise of the Tomb Raider* courtesy of Crystal Dynamics/Square Enix, 2015.)

FIGURE 15.18 Nintendo Switch. ("A Nintendo Switch video game console shown in docked mode and Joy-Con controllers in grip configuration." By Owen1962 - own work. Public domain. Available at https://commons.wikimedia.org/w/index.php?curid=56950688. Retrieved from https://en.wikipedia.org/wiki/File:Nintendo_Switch_Console.png)

FIGURE 15.19 Modern generation console sales graph (as of early 2018). (Designed by Wardyga using data from VGChartz. (2017). Global Hardware Totals. Retrieved from http://www.vgchartz.com/)

Pro File: Mark Cerny. Photo credit: By Katsura Cerny. Mark Cerny, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=9902481.

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