SECTION 3

Technology and Modern Life

MAIN IDEA	WHY IT MATTERS NOW	Terms & Names
Advances in technology have increased the pace but also the comfort of many Americans' daily lives.	Providing access to the new technology and regulating its use are two current challenges facing 21st-century America.	• information superhighway • Internet • telecommute • Telecommunications Act Of 1996 • genetic engineering

One American's Story

The crowds stand four-deep cheering for 12-year-old Rudy Garcia-Tolson as he captures a new national record for his age group at the San Diego half-marathon. Despite the loss of his legs, Rudy competes in sports and won a gold medal in swimming at the 2004 paralympics.

For years, Rudy was confined to a wheelchair. After undergoing a double amputation he was fitted with carbon fiber prostheses—artificial replacements for missing body parts. These lightweight, strong, and durable new legs now make many things possible for Rudy.

A Personal Voice RUDY GARCIA-TOLSON

"I told them to cut my legs off. I saw pictures of people running with prosthetic legs. I didn't want to stay in a wheelchair. . . . My legs won't stop me. Nothing stops me. . . . I like to show kids that there's no limitations—kids or challenged people or adults, there's no limitations to what a person can do. . . . My motto is, if you have a brave heart, that's a powerful weapon."

—quoted in *Press-Enterprise*, January 1, 2000

Rudy Garcia-Tolson, 2001

Advances in medical technology have permitted Rudy to live a more fully active life. Throughout the 20th century and into the 21st, technological developments helped Americans become more active in many ways.

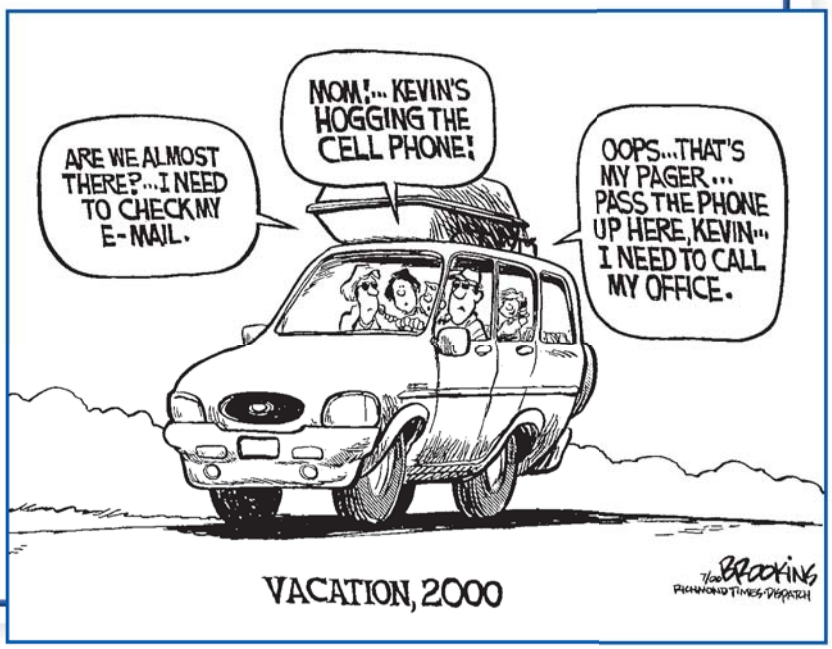
The Communications Revolution

The computer industry transformed the 1980s. Instead of giant mainframes and minicomputers, desktop workstations now ruled business. Home computers became widely available, and many thousands of people joined online subscription services that provided electronic mail and magazine-style information.

Analyzing Political Cartoons

"VACATION, 2000"

By the end of the 20th century, millions of Americans owned any number of personal communication devices. People were able to speak to or correspond with each other instantaneously almost anytime, almost anywhere. The cartoon suggests that Americans are dependent on their communication devices, and that the once relaxing and peaceful family vacation has given way to the hustle and bustle of constant access.



SKILLBUILDER

Analyzing Political Cartoons

1. What modern-day communication devices are being used in this cartoon?
2. In what ways do the characters in this cartoon seem trapped by modern-day communications technology?

SEE SKILLBUILDER HANDBOOK, PAGE R24.

ENTERING THE INFORMATION AGE The **information superhighway**—a network of communication devices linking people and institutions across the nation and the world—promised to advance the revolution that had begun with the personal computer. In 1994, Vice President Al Gore began to oversee the government's participation in developing this superhighway. Even though private industries would build the superhighway, the government would keep access democratic, ensure affordable service for everyone, protect privacy and property rights, and develop incentives for investors.

The 1990s enjoyed explosive growth of the **Internet,** an international network linking computers and allowing almost instant transmittal of text, images, and sound. Originally developed in the late 1960s by the U.S. Department of Defense for defense research, the Internet drew early popularity at universities. By the mid-1990s *Internet* became a household word. Use of the network was further popularized by the World Wide Web, which provided a simple visual interface for words and pictures to be seen by an unlimited audience. As businesses, schools, and organizations began to use the Web as a primary form of communication, new forms of social interaction emerged. Users developed "electronic presence" in virtual worlds, fantasy environments created with electronics.

Vocabulary
interface: the point of communication between a computer and any other entity, such as a printer or human operator

NEW TOOLS, NEW MEDIA Through an electronic connection, such as a TV cable or phone line, users accessed an array of media, from streaming video to research archives, from on-line shopping catalogs to customized news broadcasts. Users could interact with each other across the world. By 2003, as many as 131 million Americans used the Internet regularly to send e-mail (electronic notes and messages), to share music, or to browse or search through "pages" on the Web. During the 1990s, classrooms across the nation increasingly used computer networking. By 2002, 92 percent of public-school classrooms offered Internet access. Long-distance video and audio transmissions also linked American students. Some content was delivered not on networks but stored on a CD-ROM (Compact Disc Read-Only Memory), which evolved from music CDs that contained code for sound waves. CD-ROMs also carry digital code for pictures, text, and animation to be played on a computer.

The late-20th-century advances in computers and communications have had an impact on American society and business comparable to the industrial developments of the late 1800s. Americans now have more entertainment options, as cable service has multiplied the number of television channels available and greater bandwidth offers the possibility for high-definition television. Because of cellular phones, fax machines, the Internet, and overnight shipping, people can more readily **telecommute,** or work out of their homes instead of going to an office every day. A

MAIN IDEA

Summarizing

A Explain the revolutionary nature of communicating via the Internet.

LEGISLATING TECHNOLOGY In the 1980s, the government was slow to recognize the implications of the new communications technology. In 1994, however, the Federal Communications Commission (FCC) began to auction the valuable rights to airwaves and collected over $9 billion. Then, with the rapid growth in the communications industry, the federal government took several steps to ensure that consumers received the best service. Congress passed the **Telecommunications Act of 1996,** removing barriers that had previously prevented one type of communications company from starting up or buying another related one. While it increased competition in the industry, the law also paved the way for major media mergers. When Capital Cities/ABC Inc. joined the Walt Disney Company, industry watchdogs noted that this reflected the trend toward concentrating media influence in the hands of a few powerful conglomerates.

The passage of the Telecommunications Act won applause from the communications industry but only mixed reviews from the public. Consumer activists worried that the law would fail to ensure equal access to new technologies for rural residents and poor people. Civil rights advocates contended that the Communications Decency Act (part of the Telecommunications Act) restricted free speech because it barred the transmission of "indecent" materials to minors via the Internet. In addition, Congress also called for a "V-chip" in television sets—a computer chip that would enable parents to block TV programs that they deemed inappropriate for their children. Parts of these laws were later struck down in court. B

MAIN IDEA

Predicting Effects

B How might the Telecommunications Act affect consumers?

Scientific Advances Enrich Lives

At NASA Langley Research Center in Virginia, an aerospace engineer wearing stereo glasses sees a 3-D view of a space station simulation, as shown in the background.

The exciting growth in the telecommunications industry in the 1990s was matched by insights that revolutionized robotics, space exploration, and medicine. The world witnessed marvels that for many of the "baby boom generation," people born in the late 1940s and the 1950s, echoed science fiction.

SIMULATION, ROBOTICS, AND MACHINE INTELLIGENCE Visual imaging and artificial intelligence (a computer's ability to perform activities that require intelligence) were combined to provide applications in industry, medicine, and education. For example, virtual reality began with the flight simulators used to train military and commercial pilots. Today, with a headset that holds tiny video screens and earphones, and with a data glove that translates hand movements to a computer screen, a user can navigate a "virtual landscape." Doctors have used virtual reality to take

a computerized tour of a patient's throat and lungs to check for medical problems. Surgeons have performed long-distance surgery through telepresence systems—gloves, computers, and robotic elements specially wired so that a doctor can operate on a patient hundreds of miles away. Architects and engineers have used virtual reality to create visual, rather than physical, models of their buildings, cars, and other designs. Modeling also affected the nightly newscast. Using supercomputers and improved satellite data, meteorologists could offer three-day weather forecasts that reached the accuracy of one-day forecasts of 1980.

As technology became more sophisticated, computers increased in capability. IBM's Deep Blue defeated chess champion Garry Kasparov in 1997. Computational linguists steadily improved natural language understanding in computers, thus fine-tuning the accuracy of voice recognition systems.

Robots grew more humanlike as engineers equipped them with high-capacity chips simulating brain function. By the year 2000, robots had the ability to walk on two legs, interact with people, learn taught behaviors, and express artificial feelings with facial gestures.

SPACE EXPLORATION In the 1990s, astronomy expanded our view of the universe. In 1997, NASA's *Pathfinder* and its rover *Sojourner* transmitted live pictures of the surface of Mars to millions of Internet users.

Shuttle missions, meanwhile, concentrated on scientific research and assembly, transport, and repair of orbiting objects, paving the way to possible human missions to Mars and other space travel in the coming century. NASA concentrated on working with other nations to build the *International Space Station (ISS)*. The *ISS* promised to offer scientists a zero-gravity laboratory for research in medicine, space mechanics and architecture, and long-term living in space. Ellen Ochoa, part of the first shuttle crew to dock to the *ISS,* hoped to inspire young students:

Background
The *International Space Station* was established by joining and expanding upon the Russian station, *Mir,* and the American *Spacelab*.

A Personal Voice ELLEN OCHOA

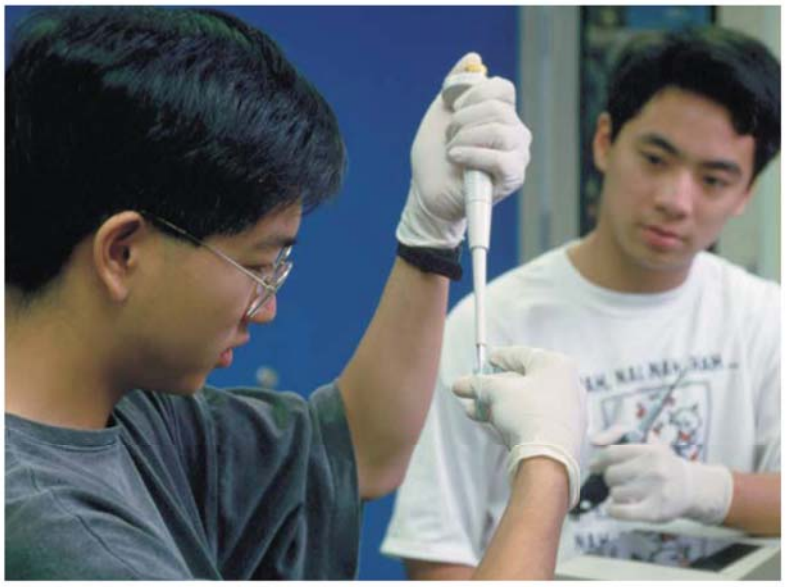
"I'm not trying to make everyone an astronaut, but I want students to think about a career and the preparation they'll need. . . . I tell students that the opportunities I had were a result of having a good educational background. Education is what allows you to stand out."

—quoted in *Stanford University School of Engineering Annual Report*, 1997–98.

Dr. Ellen Ochoa

Another shuttle crew in 1993 aboard the *Endeavour* repaired the Hubble Space Telescope, which returns dazzling intergalactic views. In late 1995, astronomers using observatories discovered a planet orbiting the fourth closest star to Earth, the first planet to be detected outside our own solar system. Since then dozens more have been detected. Astronomers back on Earth have also spent considerable effort tracking asteroids and comets whose paths might collide with our planet. Astrobiologists hailed the discovery on Antarctica of a small meteorite that traveled to Earth from Mars about 15 million years ago.

BIOTECHNOLOGY The most profound insight into the book of life came from the field of biotechnology. The Human Genome Project, an international effort to map the genes of the human body, and Celera, a private company in molecular biology, simultaneously announced in 2000 that they had sequenced nearly all of the human genome only a decade after the research began. Cooperation via the Internet and access to computerized databases by multiple research groups vastly accelerated the scientists' ability to identify and order over three billion chemical



High school students Li-Ho *(left)* and Yu-Fong Hong *(right)*, among the youngest scientists to have worked on the Human Genome Project, are shown at a San Ramon, California, laboratory.

"letters" of the genetic code of DNA. Molecular biologists hoped that this genetic map would offer the key to treating many inherited diseases and diagnosing congenital disabilities, and that drug makers could one day design pharmaceuticals for each patient's particular profile.

DNA had been in the spotlight before the breakthrough announcement. In well-publicized legal proceedings, prosecutors relied on DNA evidence to help prove the guilt of defendants who may have left behind a single hair at a crime scene. Others, wrongly imprisoned, were released when genetic analysis proved their innocence.

But different opinions arose over some of the new "biotechnology." Some speculated that technological progress outpaced social evolution and society's ability to grapple with the consequences. In 1997, Scottish researchers cloned Dolly the sheep from one cell of an adult sheep. Shortly thereafter, two Rhesus monkeys were cloned in Oregon, and many wondered whether human cloning was next. Firms sought to patent genes used for medical and research applications, using the principle of invention and property. Advances such as these, as well as gene therapy, artificial human chromosomes, and testing embryos for genetic defects all sparked heated debates among scientists, ethicists, religious leaders, and politicians.

The use of **genetic engineering**—the artificial changing of the molecular biology of organisms' cells to alter an organism—also aroused public concern. However, the Federal Department of Agriculture (FDA) holds that genetically engineered foods are safe and that they require no extra labeling. Scientists in the late 1990s modified corn and rice to provide resistance to pests and increase nutritional value. In 1996, the European Union limited the importation of such products in response to consumer pressure, allowing only those clearly labeled as having been genetically modified.

MEDICAL PROGRESS People suffering from some diseases benefited from advances in medicine in the 1990s. Cancer survival rates improved drastically as clinicians explored the use of gene therapy, genetically engineered antibodies, and immune system modulation. Improvements in tracking the spread of HIV—the virus that causes AIDS (acquired immune deficiency syndrome)—through the body made researchers better prepared to find a cure. AIDS patients were treated with combination therapies, and public health officials advocated abstinence and "safer sex" practices to control the spread of HIV.

Background
In 1998, fewer than 13,500 Americans died from AIDS, roughly one-third the 1992 number.

Improved technology for making medical diagnoses offered new hope as well. Magnetic resonance imaging (MRI), for example, was used to produce cross-sectional images of any part of the body. Advances that will make the MRI procedure ten times faster will also make MRI more widely available and cheaper to use. Medical researchers look ahead to using fleets of tiny "nanosensors" one-thousandth the width of a human hair to find tumors and to deploying "nanobots" to repair tissues and even genes. C

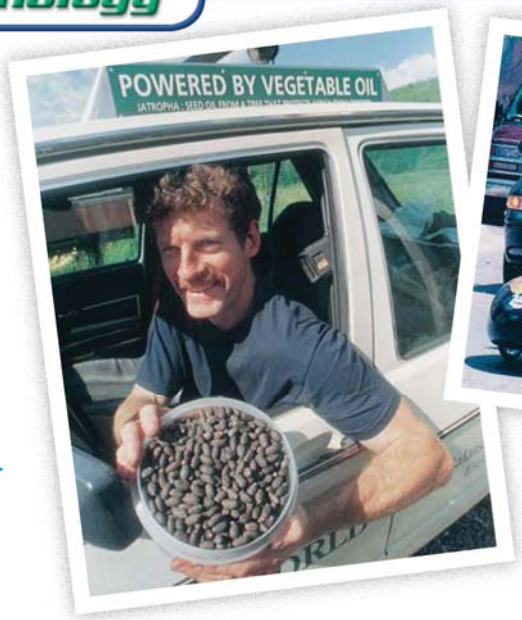
MAIN IDEA

Summarizing
C Describe how technology affected health care.

Science & Technology

ALTERNATIVE CARS

In an effort to reduce the nation's dependence on fossil fuels, researchers have been working to develop a "cleaner" car, or one that runs on something other than gasoline. Such alternative models include an electric car, which uses a rechargable battery and gas power, and a vehicle that runs on compressed natural gas.



Carl Bielenberg of Calais, Vermont, holds a container of seeds of the jatropha plant. He runs his compact car on vegetable oil that is made from the seed.

A solar-powered car built by high school students from Saginaw, Michigan, makes its way through busy traffic.

ENVIRONMENTAL MEASURES With the spreading use of technology came greater concern about the impact of human activities on the natural environment. Scientists have continued examining ways to reduce American dependence on pollution-producing fossil fuels. Fossil fuels such as oil provided 85 percent of the energy in the United States in the 1990s but also contributed to poor air quality, acid rain, and global warming. Many individuals have tried to help by reducing consumption of raw materials. By the early 1990s, residents set out glass bottles and jars, plastic bottles, newspapers, phone books, cardboard, and aluminum cans for recycling at curbsides, and consumers purchased new products synthesized from recycled materials.

SECTION 3 ASSESSMENT

1. TERMS & NAMES For each term or name, write a sentence explaining its significance.

- information superhighway
- Internet
- telecommute
- Telecommunications Act of 1996
- genetic engineering

MAIN IDEA

2. TAKING NOTES
On a chart like the one shown, list four of the technological changes described in this section and explain how each change has affected your life.

Technological Change	Effect on Me
1.	
2.	
3.	
4.	

CRITICAL THINKING

3. MAKING INFERENCES
Explain how government, business, and individuals are important to the existence of the information superhighway. **Think About:**

- the costs of developing the superhighway
- the equipment and personnel needed to maintain it
- who uses the superhighway and why they use it

4. ANALYZING ISSUES
Why is genetic engineering a source of controversy?

5. EVALUATING
Which area of technological change described in this section do you think was the most important one for the country? Explain.