



The Impact of Science and Technology

MAIN IDEA

SCIENCE AND TECHNOLOGY

Advances in technology after World War II led to increased global interaction and improved quality of life.

WHY IT MATTERS NOW

Advances in science and technology affect the lives of people around the world.

TERMS & NAMES

- International Space Station
- Internet
- genetic engineering
- cloning
- green revolution

SETTING THE STAGE Beginning in the late 1950s, the United States and the Soviet Union competed in the exploration of space. The Soviets launched Earth's first artificial satellite and put the first human in orbit around the planet. By the late 1960s, however, the United States had surpassed the Soviets. U.S. astronauts landed on the moon in 1969. The heavy emphasis on science and technology that the space race required led to the development of products that changed life for people across the globe.

Exploring the Solar System and Beyond

In its early years, competition between the United States and the Soviet Union in the space race was intense. Eventually, however, space exploration became one of the world's first and most successful arenas for cooperation between U.S. and Soviet scientists.

Cooperation in Space In 1972, years before the end of the Cold War, the United States and Soviet space programs began work on a cooperative project—the docking of U.S. and Soviet spacecraft in orbit. This goal was achieved on July 17, 1975, when spacecraft from the two countries docked some 140 miles above Earth. Television viewers across the globe watched as the hatch between the space vehicles opened and crews from Earth's fiercest rival countries greeted each other.

This first cooperative venture in space between the United States and the Soviet Union was an isolated event. People from different countries, however, continued to work together to explore space. The Soviets were the first to send an international crew into space. The crew of *Soyuz 28*, which orbited Earth in 1978, included a Czech cosmonaut. Since the mid-1980s, crews on United States space shuttle flights have included astronauts from Saudi Arabia, France, Germany, Canada, Italy, Japan, Israel, and Mexico. (Space shuttles are larger than other spacecraft and are reusable.) Shuttle missions put crews in orbit around Earth to accomplish a variety of scientific and technological tasks.

The space shuttle is being used in the most ambitious cooperative space venture. The project, sponsored by the United States, Russia, and 14 other nations, involves the building of the **International Space Station** (ISS). Since 1998, U.S. shuttles and Russian spacecraft have transported sections of the ISS to be assembled in space. By the time it is completed, the ISS will cover an area the size

CALIFORNIA STANDARDS

10.11 Students analyze the integration of countries into the world economy and the information, technological, and communications revolutions (e.g., television, satellites, computers).

CST 3 Students use a variety of maps and documents to interpret human movement, including major patterns of domestic and international migration, changing environmental preferences and settlement patterns, the frictions that develop between population groups, and the diffusion of ideas, technological innovations, and goods.

TAKING NOTES

Recognizing Effects Use a chart to list the effects of scientific and technological developments.

Developments	Effects
Communications	
Health and Medicine	
Green Revolution	



▲ This view of the ISS was taken from the space shuttle *Endeavor*.

of a football field and house a crew of six. Since October 2000, smaller crews have been working aboard the ISS. By early 2003, they had conducted more than 100 experiments. However, the suspension of the shuttle program after the crash of the shuttle *Columbia* in February 2003 put the future of the ISS in question.

Exploring the Universe Unmanned space probes have been used to study the farther reaches of the solar system. The Soviet *Venera* spacecraft in the 1970s and the U.S. probe *Magellan* in 1990 provided in-depth information about Venus. On a 12-year journey that began in 1977, the U.S. *Voyager 2* sent dazzling pictures of Jupiter, Saturn, Uranus, and Neptune back to Earth. Both the United States and the Soviet Union have shown particular interest in the planet Mars. The United States probe *Pathfinder*, which landed on Mars in 1997, provided spectacular results.

In 1990, the U.S. space agency, NASA, and the European space agency, ESA, worked together to develop and launch the Hubble Space Telescope. This orbiting telescope continues to observe and send back images of objects in the most remote regions of the universe. **A**

MAIN IDEA

Hypothesizing

A Why might rival nations cooperate in space activities but not on Earth?

Expanding Global Communications

Since the 1960s, artificial satellites launched into orbit around Earth have aided worldwide communications. With satellite communication, the world has been gradually transformed into a global village. Today, political and cultural events occurring in one part of the world often are witnessed live by people thousands of miles away. This linking of the globe through worldwide communications is made possible by the miniaturization of the computer.

Smaller, More Powerful Computers In the 1940s, when computers first came into use, they took up a huge room. The computer required fans or an elaborate air-conditioning system to cool the vacuum tubes that powered its operations. In the years since then, however, the circuitry that runs the computer has been miniaturized and made more powerful. This change is due, in part, to the space program, for which equipment had to be downsized to fit into tiny space capsules. Silicon chips replaced the bulky vacuum tubes used earlier. Smaller than contact lenses, silicon chips hold millions of microscopic circuits.

Following this development, industries began to use computers and silicon chips to run assembly lines. Today a variety of consumer products such as microwave ovens, telephones, keyboard instruments, and cars use computers and chips. Computers have become essential in most offices, and millions of people around the globe have computers in their homes.

▼ Some computers are so small that they can be held in the hand.



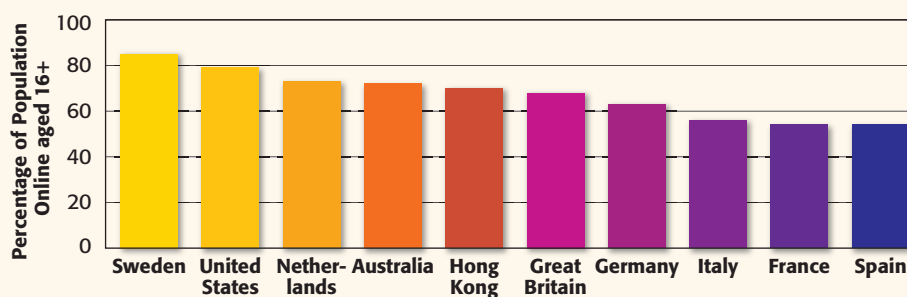
Access to the Internet, 2002

Internet Users Worldwide

Africa	6.31 million
Asia and the Pacific	187.24 million
Europe	190.91 million
Middle East	5.12 million
Canada and U.S.	182.67 million
Latin America	33.35 million
Worldwide	605.60 million

Source: Nua Internet Surveys

Some Major Internet Nations (By Percentage of Population Online)



Source: Nielsen/NetRatings

SKILLBUILDER: Interpreting Charts and Graphs

- Comparing** In which world region do most Internet users live?
- Drawing Conclusions** How would you describe most of the nations with large percentages of their populations online?

Communications Networks Starting in the 1990s, businesses and individuals began using the **Internet**. The Internet is the voluntary linkage of computer networks around the world. It began in the late 1960s as a method of linking scientists so they could exchange information about research. Through telephone-line links, business and personal computers can be hooked up with computer networks. These networks allow users to communicate with people across the nation and around the world. Between 1995 and late 2002, the number of worldwide Internet users soared from 26 million to more than 600 million.

Conducting business on the Internet has become a way of life for many. The Internet, along with fax machines, transmits information electronically to remote locations. Both paved the way for home offices and telecommuting—working at home using a computer connected to a business network. Once again, as it has many times in the past, technology has changed how and where people work. **B**

MAIN IDEA

Summarizing

B What types of technology have recently changed the workplace?

Transforming Human Life

Advances with computers and communications networks have transformed not only the ways people work but lifestyles as well. Technological progress in the sciences, medicine, and agriculture has improved the quality of the lives of millions of people.

Health and Medicine Before World War II, surgeons seldom performed operations on sensitive areas such as the eye or the brain. However, in the 1960s and 1970s, new technologies, such as more powerful microscopes, the laser, and ultrasound, were developed. Many of these technologies advanced surgical techniques.

Advances in medical imaging also helped to improve health care. Using data provided by CAT scans and MRI techniques, doctors can build three-dimensional images of different organs or regions of the body. Doctors use these images to diagnose injuries, detect tumors, or collect other medical information.

In the 1980s, genetics, the study of heredity through research on genes, became a fast-growing field of science. Found in the cells of all organisms, genes are hereditary units that cause specific traits, such as eye color, in every living organism. Technology allowed scientists to isolate and examine individual genes that are responsible for different traits. Through **genetic engineering**, scientists were able to introduce new genes into an organism to give that organism new traits.

Another aspect of genetic engineering is **cloning**. This is the creation of identical copies of DNA, the chemical chains of genes that determine heredity. Cloning actually allows scientists to reproduce both plants and animals that are identical to

Social History

Molecular Medicine

In 2003, scientists employed on the Human Genome Project completed work on a map of the thousands of genes contained in DNA—human genetic material. The information provided by this map has helped in the development of a new field of medicine. Called “molecular medicine,” it focuses on how genetic diseases develop and progress.

Researchers in molecular medicine are working to identify the genes that cause various diseases. This will help in detecting diseases in their early stages of development. Another area of interest to researchers is gene therapy. This involves replacing a patient’s diseased genes with normal ones. The ultimate aim of workers in this field is to create “designer drugs” based on a person’s genetic makeup.

existing plants and animals. The application of genetics research to everyday life has led to many breakthroughs, especially in agriculture.

The Green Revolution In the 1960s, agricultural scientists around the world started a campaign known as the **green revolution**. It was an attempt to increase food production worldwide. Scientists promoted the use of fertilizers, pesticides, and high-yield, disease-resistant strains of a variety of crops. The green revolution helped avert famine and increase crop yields in many parts of the world.

However, the green revolution had its negative side. Fertilizers and pesticides often contain dangerous chemicals that may cause cancer and pollute the environment. Also, the cost of the chemicals and the equipment to harvest more crops was far too expensive for an average peasant farmer. Consequently, owners of small farms received little benefit from the advances in agriculture. In some cases, farmers were forced off the land by larger agricultural businesses.

Advances in genetics research seem to be helping to fulfill some of the goals of the green revolution. In this new “gene revolution,” resistance to pests is bred into plant strains, reducing the need for pesticides. Plants being bred to tolerate poor soil conditions also reduce the need for fertilizers. The gene revolution involves some risks, including the accidental

creation of disease-causing organisms. However, the revolution holds great promise for increasing food production in a world with an expanding population. **C**

Science and technology have changed the lives of millions of people. What people produce and even their jobs have changed. These changes have altered the economies of nations. Not only have nations become linked through communications networks but they are also linked in a global economic network, as you will see in Section 2.

MAIN IDEA

Recognizing Effects

C What are some of the positive and negative effects of genetic engineering?

SECTION 1 ASSESSMENT

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

- International Space Station
- Internet
- genetic engineering
- cloning
- green revolution

USING YOUR NOTES

2. Which of the three developments do you think has had the greatest global effect? Why? (10.11)

Developments	Effects
Communications	
Health and Medicine	
Green Revolution	

MAIN IDEAS

3. How does the development of the International Space Station show that space exploration has become a cooperative endeavor? (10.11)
4. How has the development of the computer and Internet changed people work? (10.11)
5. What areas of medicine have benefited from scientific and technological developments? (10.11)

CRITICAL THINKING & WRITING

6. **MAKING INFERENCES** Why do you think that space exploration became an arena for cooperation between the Soviet Union and the United States? (10.11)
7. **HYPOTHESIZING** How do you think the Internet will affect the world of work in the future? (10.11)
8. **FORMING AND SUPPORTING OPINIONS** Is there a limit to how far cloning should go? Why or why not? (10.11)
9. **WRITING ACTIVITY** **SCIENCE AND TECHNOLOGY** Use encyclopedia yearbooks and science magazines to identify a technological advance made in the last year. Write a brief report on its impact on daily life. (Writing 2.3.b)

CONNECT TO TODAY CREATING A GRAPH

Conduct research into how people use the Internet. Use your findings to construct a **graph** showing the most common Internet activities. (Writing 2.3.d)