

## LESSON 4

# Science, Technology, and the Environment

### ESSENTIAL QUESTION

How do social and environmental issues affect countries differently?

### READING HELPDESK

#### Academic Vocabulary

- intense
- manipulation

#### Content Vocabulary

- microchip
- ecology
- deforestation
- desertification
- greenhouse effect
- sustainable development

### TAKING NOTES

#### Key Ideas and Details

**Summarizing** As you read, use a table like the one below to identify important technological advances discussed in this lesson.

Communication, Transportation, and Space	Health Care	Agriculture

### IT MATTERS BECAUSE

*In the twenty-first century, science and technology continue to build a global community connected by the Internet. Scientific advances have brought benefits in communications, transportation, space exploration, health care, and agriculture. Unfortunately, they have also produced environmental challenges.*

## Technological Revolution

**GUIDING QUESTION** *How have scientific discoveries and technological innovations transformed society?*

Since World War II, but especially since the 1970s, a stunning array of changes has created a technological revolution. Like the first and second Industrial Revolutions, this revolution is also having a profound effect on people's daily lives and on entire societies. This technological revolution is also closely interrelated with new scientific discoveries.

### Communication, Transportation, and Space

Global transportation and communication systems are transforming the world community. People are connected and "online" throughout the world as they have never been before. Space exploration and orbiting satellites have increased our understanding of our world and of solar systems beyond our world.

Since the 1970s, jumbo jet airliners have moved millions of people around the world each year. A flight between London and New York took half a day in 1945. Now that trip takes only five or six hours. The Internet—the world's largest computer network—provides quick access to vast quantities of information. The World Wide Web, developed in the 1990s, has made the Internet even more accessible to people everywhere. Satellites, cable television, cellular telephones, and computers enable people to communicate with one another practically everywhere in the world. Communication and transportation systems have made the world a truly global village.

The computer may be the most revolutionary of all technological inventions of the twentieth century. The first computer was really a product of World War II. British mathematician Alan Turing designed the first electronic computer to crack enemy codes. Turing's machine did calculations faster than any human. IBM of the United States made the first computer with stored memory in 1948. These early computers used thousands of vacuum tubes to function and took up considerable space. The development of the transistor and the silicon chip produced a revolutionary new approach to computers.

Then, in 1971, the microprocessor was invented and paved the way for the personal computer. Both small and powerful, the personal computer became a regular fixture in businesses, schools, and homes by the 1990s. The computer made many routine tasks easier and has become important in nearly every area of modern life. Other tools and machines, such as those that help fly airplanes, depend on computers to function.

Through their personal computers, people can access the Internet, a huge web of linked computer networks. The Internet was introduced to the public for the first time in 1972. That same year, electronic mail, or e-mail, was introduced. The system mushroomed, and by the early 1990s, a new way of sending Internet information, called hypertext transfer protocol (http), had been developed. This, combined with the invention of Web browsers, made it easier for people to use the Internet. By 2015, there were more than 3 billion Internet users worldwide.

As Web capabilities increased, new forms of communication began to emerge with Twitter, a communications platform that allows people to send instant updates from their computers or cell phones to their followers. Facebook, a social networking site, and YouTube, an Internet video site that provides instant visual access to many events, are also important.

Advances in telecommunications led to cellular, or mobile, phones. Though cellular phones existed in the 1970s and the 1980s, it was not until the invention of the **microchip**, a small semiconductor used to relay information, that cell phones became truly portable. Cell phones have since become enormously important. Cell phones are everywhere, and their ability to transfer data electronically has made text messaging a standard form of communication. Text and instant messaging have revolutionized written language, as shorthand script has replaced complete sentences for the purposes of relaying brief messages.

**microchip** also called an integrated circuit; a tiny assembly of electronic components and their connections that is produced in or on a tiny bit of material, usually silicon

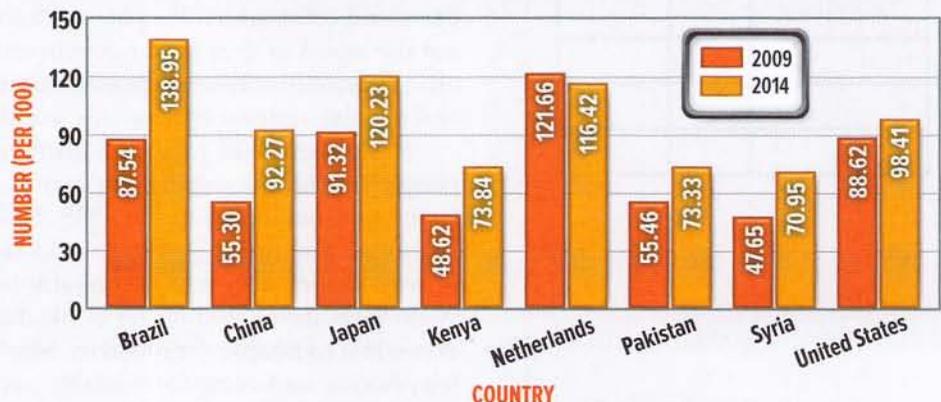
**intense** marked by great zeal, energy, determination, or concentration

## CHARTS/GRAPHS

### MOBILE PHONE SUBSCRIPTIONS PER 100 PEOPLE

#### ► CRITICAL THINKING

- 1 Drawing Conclusions** How do developed and developing countries differ in their access to mobile phones?
- 2 Making Inferences** Which countries had more than 100 mobile phone subscriptions per 100 people in 2014? Explain how this is possible.



Source: International Telecommunications Union, 2015

Technological developments have also improved our ability to explore space. Ever since Neil Armstrong and Buzz Aldrin landed on the moon in 1969, the exploration of space has continued. Space probes have increased our understanding of distant planets.

Today hundreds of satellites orbit Earth. Some are used to predict the weather, and others help navigate ships, aircraft, and cars. Communications satellites are used to relay radio, television, and telephone signals.

Launched in 1990, the Hubble Space Telescope (HST), a large astronomical observatory, orbits about 375 miles (603 km) above Earth's surface. Thus, the HST avoids the distorting effects of the Earth's atmosphere and provides clear views of our solar system and distant galaxies.

The National Aeronautics and Space Administration (NASA) sent two rovers, called *Spirit* and *Opportunity*, to the planet Mars in 2004. Based on the minerals that the rovers found in Mars's rocks, NASA scientists determined that the now-barren planet once had abundant supplies of water. NASA continues its Mars Exploration Program, analyzing data transmissions from rovers to Earth via the *Odyssey* orbiter, which was launched in 2001. Such data includes radiation risks for potential future human exploration of Mars.

## Health Care

New technologies in health care have allowed people to live longer and more productive lives. For example, doctors use mechanical valves and pumps for the heart and transplant organs. New medicines can treat both physical and mental illness. Scientific research has also led to improvements. From 1990 to 2003, the Human Genome Project unlocked the secrets of DNA, leading to new ways to diagnose and treat genetic diseases. The discovery of DNA itself—the molecule that carries genetic information from one generation to another—was the work of James Watson, Francis Crick, and Maurice Wilkins, who received a joint Nobel Prize for Medicine in 1962.

These new technologies have broadened the field of bioethics, which deals with moral choices in medical research. There are concerns that genetic engineering, or the altering of genetic information of cells to produce new variations, could create deadly strains of bacteria. The possibility of human cloning, along with stem-cell research (using stem cells from human embryos to research cures for certain diseases), has caused **intense** debate in many countries.

## Agriculture

In agriculture, the development of new strains of rice, corn, and other grains, known as genetically engineered (GE) foods, have resulted in greater yields. Scientists and world leaders disagree over the use of GE foods, which are created by the **manipulation** of the DNA of plants to improve crops. Some experts see GE foods as a way to solve hunger crises in developing countries, although others worry about the effects GE foods have on the health of



▲ From 2000 to 2010, 196 individuals from eight different countries have visited the International Space Station.

### ► CRITICAL THINKING

**Speculating** There have been over 100 launches to the space station. Which two countries do you think have sent the most vehicles? Why?

**manipulation** skillful or artful management

## Connections to TODAY

### Medical Advancements

Many medical advancements that have had a major impact on our lives today were developed during World War II. For example, Charles R. Drew, an African-American physician, started the American Red Cross blood banking program to assist soldiers. Today, nearly 3 percent of the U.S. population donates blood, which is used to save military and civilian lives across the country. Likewise, Dr. Jonas Salk developed vaccines for flu and polio. Today, mass vaccinations prevent many childhood illnesses each year, and polio is close to being eradicated globally.



▲ A farmer clears an area of the Amazon rain forest.

### ► CRITICAL THINKING

#### **Determining Cause and Effect**

What may be the global effects of deforestation on the environment?

**ecology** the study of the relationships between living things and their environment

**deforestation** the clearing of forests

**desertification** formation of degraded soil, turning semi-arid lands into nonproductive deserts

individuals and the ecosystem. Huge quantities of chemical fertilizers, which many farmers cannot afford, are needed to grow these new strains of foods.

The growing concern with chemical pesticides has led to an increase in organic farming in industrialized countries and the profitable export of organically grown crops by developing nations. Organic farming rejects the use of chemical fertilizers and pesticides, growth hormones, and livestock feed additives. Its goal is to maintain a healthy and sustainable environment.

### ✓ READING PROGRESS CHECK

**Identifying Points of View** What are the arguments for and against the use of GE foods?

## Environmental Challenges

**GUIDING QUESTION** What are the environmental challenges of the twenty-first century and how have governments and citizens responded to them?

In *Silent Spring*, published in 1962, Rachel Carson, an American scientist, argued that the buildup of pesticides—chemicals sprayed on crops to kill insects—was having unforeseen results. Insects were dying, but so too were birds, fish, and other wild animals. Also, the pesticide residue on food harmed humans.

Carson's warnings alarmed many scientists and gave rise to the new science of **ecology**, the study of the relationship between living things and their environment. Since then, scientific research studies have shown that dangers to the environment have many sources.

### Impact of Population Growth

Some fear that population is growing too fast for Earth's resources to support it. **Deforestation** is one by-product of a growing population. Forests and jungles have been cut down to provide more farmland, firewood, and timber. Deforestation can lead to habitat destruction and loss.

Especially worrisome is the rapid destruction of tropical rain forests near Earth's equator. Although tropical rain forests cover only 6 percent of Earth's surface, they support 50 percent of the world's species of plants and animals. The tropical rain forests are also crucial to human survival because they remove carbon dioxide from the air and return oxygen to it.

**Desertification** is another by-product of population growth. Overgrazing, poor cultivation practices, and destruction of vegetation in semiarid lands are human-caused factors that destroy the soil's productivity. More than 250 million people are directly affected by desertification.

### Chemical Wastes and Disasters

Chemical wastes pose another danger to the environment. The release of chlorofluorocarbons—gases used in aerosol cans, refrigerators, and air conditioners—destroys the ozone layer. This thin layer in the upper atmosphere shields Earth from the sun's ultraviolet rays. Acid rain results when sulfur from factories mixes with moisture in the air. Acid rain is responsible for killing forests and damaging buildings.

Ecological disasters also leave long-lasting consequences. Toxic fumes from a chemical plant at Bhopal, India, in 1984; a nuclear accident at Chernobyl, Ukraine, in 1986; an oil spill from the *Exxon Valdez* in Alaska in 1989; and an oil platform explosion in the Gulf of Mexico in 2010 caused ecological and health problems that can still be seen today.

Yet another threat to the environment is global climate change, which has the potential to create a worldwide crisis. Many of the world's scientists agree that the **greenhouse effect**, the warming of Earth due to the buildup of carbon dioxide in the atmosphere, is contributing to devastating droughts and storms, the melting of the polar ice caps, and rising sea levels that could flood coastal regions in the second half of the twenty-first century. Also alarming is the potential loss of biodiversity. Seven out of ten biologists believe the planet is now experiencing a surprising extinction of both plant and animal species.

In an attempt to reduce carbon emissions, more than 150 nations have signed the Kyoto Protocol, which calls on countries to cut air pollution. The United States did not ratify the treaty, saying that the required changes would be too costly. In December 2015, 196 countries approved a historic climate pact to stabilize global warming, known as the Paris Agreement.

A number of nations, however, have already begun to reduce their dependence on fossil fuels by introducing geothermal and hydroelectric power plants. Another clear source of energy is wind. Scientists estimate that one-third of the world's electricity could be supplied by wind generators by 2050. That would be enough to prevent 113 billion metric tons of carbon dioxide from entering the atmosphere each year. Wind farms have sprouted around the world—including in the United States.

### Sustainable Development

Economic development that does not limit the ability of future generations to meet their basic needs is known as **sustainable development**. In promoting sustainable development, the United Nations urges countries to work to conserve all natural resources. Many countries have already enacted recycling and water conservation programs, along with curbing the dumping of toxic materials. A limited water supply affects close to 700 million globally. People without access to a source of clean water often get sick with cholera, typhoid, and diarrhea. More than 3 million people die every year from the lack of water or from drinking untreated water.

#### READING PROGRESS CHECK

**Summarizing** How have nations responded to global environmental challenges?

### greenhouse effect

global warming caused by the buildup of carbon dioxide in the atmosphere

### sustainable development

economic development that does not limit the ability of future generations to meet their basic needs

▼ Rooftop gardens, like the one below, help the environment by insulating the roof which helps save energy.



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## LESSON 4 REVIEW

### Reviewing Vocabulary

1. **Drawing Conclusions** How can sustainable development prevent deforestation and desertification?

### Using Your Notes

2. **Identifying** Use your notes to identify the technological breakthroughs discussed in this lesson.

### Answering the Guiding Questions

3. **Evaluating** How have scientific discoveries and technological innovations transformed society?

4. **Identifying Central Issues** What are the environmental challenges of the twenty-first century, and how have governments and citizens responded to them?

### Writing Activity

5. **Narrative** Identify a technology discussed in the lesson and write an essay about how this technology has affected your life. The essay should also include thoughts on how your life would be different without this technology.