

Advances in Technology and Exchange

Technology made large populations possible; large populations now make technology indispensable.

—Joseph Krutch, writer and naturalist (1893–1970)

Essential Question: How has the development of new technology changed the world since 1900?

While the population of the world grew, globalization made the world feel smaller, as did advances in telecommunications technology. Starting in the early 1900s, **radio** brought news, music, and cultural events to a wide range of people. Later in the century, air travel and **shipping containers**, large standard-sized units that could be carried on a truck or train or stacked on ship, promoted the widespread movement of people and goods. Energy technologies, such as the use of oil and nuclear power, made it possible to transport goods faster and more cheaply than ever. The internet, first developed for the U.S. Defense Department during the Cold War, emerged as a regular tool of communication for much of the public by the late 1990s. Knowledge economies, based on developing or sharing information, took root in cities around the world.

Communication and Transportation

Decades before the introduction of the internet, communication technologies were connecting people around the world. Television and radio ads encouraged people to “reach out and touch someone” by making a long-distance phone call. By the 1990s, mobile technologies such as cellphones put the tools of information creation and dissemination into the hands of individuals around the world. Twitter, Facebook, and other social networking sites made the media accessible to anyone anywhere.

The impact of this revolution became apparent quickly. Videos taken on phones of police actions in the United States and other countries led to inquiries into racial profiling and sparked outrage. Social media also played a role in the “Arab Spring,” a series of antigovernment protests that spread from country to country in North Africa and the Middle East in the 2010s as people shared their protest experiences on social media.



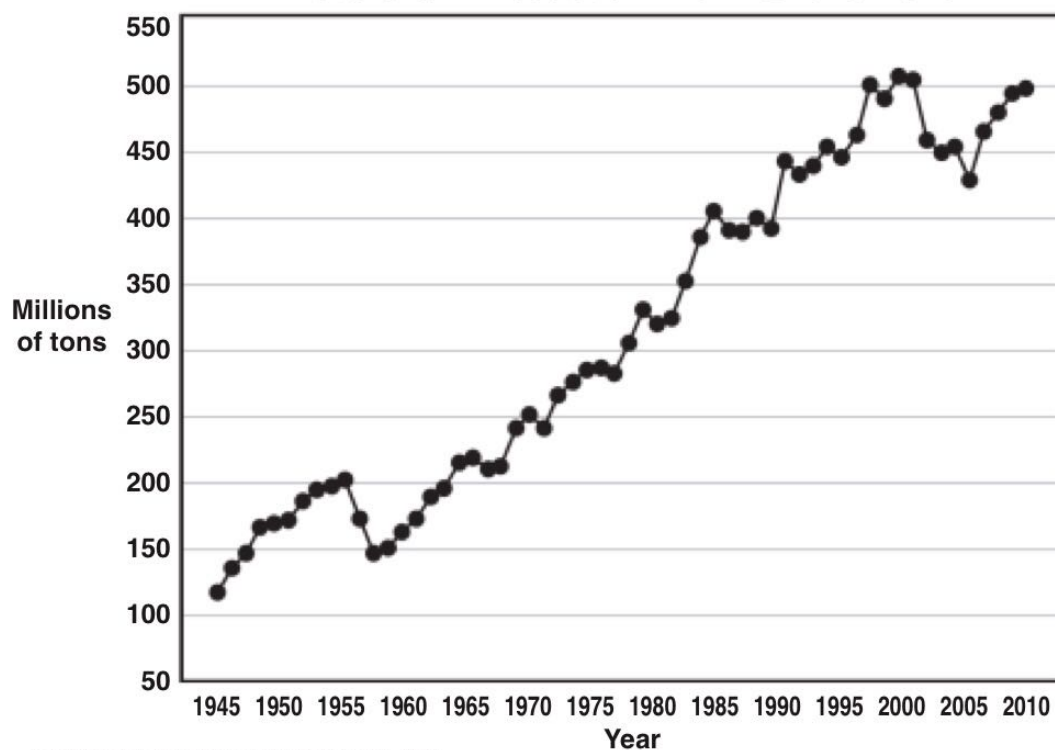
While communication technologies put people in virtual touch, transportation advancements move people and goods into actual proximity. Every day, about 2 million people fly on an airplane. Cargo planes transport commercial shipments around the clock. Giant tankers—up to one-quarter mile in length—loaded with thousands of shipping containers ply the seas in increasing numbers, some of them too big to fit through the Panama Canal.

The Green Revolution

In the mid-20th century, the **Green Revolution** emerged as a possible long-term response to hunger. Scientists developed new varieties of wheat, rice, and other grains that had higher yields and greater resistance to pests, diseases, and drought. The new varieties were first developed by **crossbreeding**—breeding two varieties of a plant to create a hybrid. More recently, scientists have used **genetic engineering**—manipulating a cell or organism to change its basic characteristics. Farmers also used more irrigation, fertilizers, and pesticides. In Brazil and elsewhere, people burned down forests and plowed the land for agriculture. Acreage devoted to crops, especially grains, increased dramatically worldwide.

The Green Revolution solutions were not free of problems. Many small farmers could not afford the new fertilizers or pesticides. For this reason, they were often unable to compete with large landowners. Many small farmers were forced to sell their land, increasing the holdings of large landowners even more. Also, since some of the techniques developed in the Green Revolution involved the use of mechanized equipment, fewer jobs were available for farm laborers. Finally, the heavy applications of chemicals damaged the soil and the environment.

Total Grain Production in China 1945–2010



Source: National Bureau of Statistics of China, 2009.

Genetic engineering created its own set of concerns as well. Some argued that a genetic modification designed to give a plant resistance to insects might inadvertently cause a decline in the population of pollinating insects, such as bees. Another problem was the loss of old seed varieties as new genetically engineered plants were adopted.

Energy Technologies

In 1900, coal accounted for about half of the global energy consumed. As extraction, refinement, and transportation technologies allowed for widespread use, petroleum, also known as crude oil, and natural gas joined coal in fueling industrial output and helped increase productivity. Research in the 1930s and 1940s that led to the atomic bomb also led to the first use of nuclear power plants to generate electricity for factories and homes.

Fossil fuels—coal, petroleum, and natural gas—are nonrenewable resources. Once they have been used up, the supply is permanently depleted. Fossil fuels have contributed to air pollution and to the cloak of greenhouse gases, especially carbon dioxide, that allow sunlight through the Earth's atmosphere but block the escape of Earth's heat. Nuclear power, while considered a clean energy, has its own dangers. Accidents at nuclear plants have caused serious problems with leaked radiation, and storing nuclear waste has hazardous consequences.

Technologies continue to be developed to combat the emission of carbon dioxide and other greenhouse gases as well as minimize harm from nuclear power. The building of nuclear power plants declined starting in the 1980s, and nuclear power accounts for only about 5 percent of global energy consumption. Renewable resources, such as wind and solar power, are beginning to supply energy to both industries and homes, but they too represent only 5 percent of global energy output. (Connect: Analyze the role of various energy sources in the first and second industrial revolutions and in the 21st century. See Topic 5.5.)

Medical Innovations

A number of advances in medicine have had a dramatic effect on the survival and longevity of humans. Medical research and advancement benefit from, and also inspire, new technologies.

Antibiotics In 1928, Scottish biologist Alexander Fleming was working in his lab in London when he accidentally discovered that a particular fungus produced a substance that killed bacteria. He had discovered penicillin. Penicillin became the first **antibiotic**, a useful agent in curing bacterial infections. During World War II, antibiotics saved the lives of soldiers who would have died in any previous war from a minor wound that became infected. After the war, antibiotics spread to civilian use, where they fought a range of illnesses.



“I would like to sound one warning,” Fleming said in a speech as he accepted the Nobel Prize. He pointed out that the extensive use of antibiotics carried a risk. By killing off certain strains of a disease, antibiotics allowed the evolution of strains of the disease unaffected by them. These antibiotic-resistant strains could be untreatable. This prospect raised fears of renewed epidemics of diseases once under control.



Source: Getty Images

Penicillium fungi are the source of penicillin, which people can take orally or by injection. Penicillin works by interfering with bacteria cell walls. Scientists began to treat humans with the drug in 1941.

Reliable Birth Control Another groundbreaking medical advance was in **birth control**. In the early 1950s, scientist Gregory Pincus developed a birth control pill, a more reliable method than the barrier methods then in use. Scientists tested the pill on women in the 1950s, and the U.S. government approved it for widespread use in 1960.

As a result of the pill and other forms of birth control, **fertility rates** declined in much of the world. In other words, the average woman began having fewer babies than her mother or grandmother had. Birth control transformed sexual practices and played a part in reshaping gender roles. By 2018, more than 300 million women worldwide were using modern forms of contraception, including the pill.

Vaccines Vaccines have existed since 1796, but governments and nonprofit organizations did not begin developing and widely distributing **vaccines** to prevent deadly diseases until after 1900. Thanks to vaccines, polio and measles became rare, and smallpox was eradicated by the 1980s. Vaccines are also available to prevent mumps, measles, tetanus, diphtheria, and whooping cough, all potentially serious diseases. As of 2019, a malaria vaccine is in the trial stage.

According to the World Health Organization (WHO), vaccines were preventing as many as 3 million deaths each year in the 21st century. However, the WHO also said that better vaccination coverage would save another 1.5 million people annually. Some people were unable to get vaccinated because they lived in hard-to-reach areas.



KEY TERMS BY THEME

SOCIETY: Communication

radio

internet

ENVIRONMENT: Ecology

Green Revolution

crossbreeding

genetic engineering

TECHNOLOGY: Travel

shipping containers

TECHNOLOGY: Medicine

antibiotic

birth control

fertility rates

vaccine