

**THE TRIUMPH OF INDUSTRY****Issues Connector: Technology and Society**

Technology and society are two forces that act on each other to spark change. A new technology, such as the water wheel or the automobile, can change the way entire nations live and work. Social change can push the demand for and development of new technologies. However, change can be difficult and frightening. Many innovations cause people social, environmental, and economic concerns. Society must decide what limits, if any, to place on controversial technologies, such as nuclear power or genetic engineering.

### Factory System

In the 1700s, innovations such as the power mill and steam-powered machines moved workers out of their rural homes and into urban factories. Men, women, and children shifted from small cottage industries to large manufacturing complexes. Tasks became automated by machines. Workers labored in assembly lines and large rooms performing steps in a process rather than making complete products themselves.

In 1814, Francis Cabot Lowell helped construct the first water-powered textile mill in the United States. Nearly ten years later, the Lowell machine shop moved to a new site along the Merrimack River. The Lowell mills primarily employed young women between the ages of 15 and 25 who had come from farming communities to find work. Between 7,000 and 8,000 young women lived in the mill town of Lowell, Massachusetts, residing in boardinghouses owned by the company. The women worked 12- and 13-hour days, beginning as early as 5:00 a.m. The mills ran six days a week. The work was exhausting and often required the women to stand all day. The air they breathed was filled with lung-irritating cotton dust. This excerpt, from a report in *The Voice of Industry*, describes the conditions in one Lowell factory.

### Oil Refining

In the United States, the first large deposits of oil were found in California in the late 1800s. In 1900, 4 million barrels of oil came out of California, largely as fuel for light and heat. That amount grew to 77 million barrels by 1910. By the end of the Second World War, the industrial nations of Europe and North America had discovered many uses for oil—as fuel for cars, planes, trucks, and tractors; as a component for making plastic, rubber, and other materials; and as an alternative energy source. As people moved from cities to suburbs, bought cars, built highways, and bought more consumer goods, the United States' consumption of oil began to outpace its production. The nation grew increasingly dependent on foreign sources of oil. Today, the United States imports more than half of its oil, the bulk of it from Canada, Mexico, Saudi Arabia, Venezuela, and Nigeria.

Oil has made possible the vast economic growth and military power of the United States, but it is a finite resource. Oil is found in underground deposits made over thousands of years by decaying organic matter. The world is using up known oil reserves at a rapidly increasing rate, and the United States is the largest consumer. The excerpts from a *National Geographic* article and the National Energy Policy statement provide insight into the uses of oil and its hazards.

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## Nuclear Reactor

During World War II, teams of scientists in Europe and North America scrambled to harness the power of the atom, a tiny particle that serves as a building block for all matter and releases explosive amounts of energy when split. In 1945, the first nuclear bomb was detonated at a test site in New Mexico. A month later, the United States dropped two nuclear bombs on the Japanese cities of Hiroshima and Nagasaki, leveling much of the cities and resulting in massive nuclear fallout that caused disease and deformities in hundreds of thousands of people. Following the war, many nations worked to build comparable nuclear weapons, but they also worked to put nuclear power to peaceful purposes, as a source of inexpensive renewable energy. In 1951, the National Reactor Testing Station in Idaho produced usable amounts of electricity—powering four light bulbs—for the first time.

In 1953, President Eisenhower proposed his “Atoms for Peace” program, intended to steer the nuclear industry toward electricity production and energy development. In 1955, Arco, Idaho, became the first town to be powered by nuclear energy. During the following decades, the nation stepped up its efforts to build nuclear power plants. However, accidents at the nuclear reactors at Three Mile Island in Pennsylvania in 1979 and at Chernobyl in the former Soviet Union in 1986 reignited fears over the hazards of nuclear explosions and radiation. At Three Mile Island, design flaws, equipment failures, and human error all contributed to the overheating of the reactor’s core. The core experienced a meltdown, or collapse, but the melted nuclear fuel did not release a massive amount of radiation. Still, some radiation was released, and pregnant women and young children within a five-mile radius were evacuated to avoid exposure.

## Genetic Engineering

Genetic engineering is the alteration of DNA—an organism’s genetic or hereditary material—or other cellular material to eliminate unwanted characteristics or to develop new features. In 1973, American scientists Stanley N. Cohen and Herbert W. Boyer first advanced this technology when they successfully split a DNA strand and rejoined different pieces of the DNA. Recombinant, or altered, DNA can strengthen food crops against viruses or insects and can make plants frost resistant. Bacteria can be changed to decompose garbage and break down petroleum products. In the medical field, genetically engineered proteins have been used to dissolve blood clots, stimulate the production of red blood cells, and produce drugs that can fight viral diseases and cancer. Genetic engineering has also contributed to the science of cloning, in which organisms are reproduced by replicating genetic material. In 1996, a sheep named Dolly gained fame as the first successfully cloned adult mammal. Scientists hope to use the technology to grow healthy organs for transplant patients.

Many people support medical and other uses of genetic engineering, but people also worry that diseases used in genetic experiments may develop into new forms and cause epidemics. Genetically altered foods draw criticism because of the threat of transferable allergens. Cloning has ignited ethical debates over the appropriate reach of science and human manipulation of life. In his book *The Biotech Century*, Jeremy Rifkin points out some of the controversial uses of genetic engineering technology.

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"The largest [room] that we saw... [had] five hundred looms, and twenty-one thousand spindles in it. The din and clatter of these five hundred looms under full operation, struck us on first entering as something frightful and infernal... [A]lthough the day was warm, ... the windows were down; we asked the reason, and a young woman answered ... that 'when the wind blew, the threads did not work so well.'"

—*A Description of Factory Life by an Associationist, 1846*

"Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine, and other peaceful activities. A special purpose [of the Atomic Energy Agency] would be to provide abundant electrical energy in the power-starved areas of the world."

—*Dwight D. Eisenhower, Address to the UN General Assembly, December 8, 1953*

"Agribusiness, pharmaceutical, and chemical companies plan to mass-produce customized and cloned animals for use as chemical factories, to secrete a range of drugs and medicines... Animal clones will also be used to harvest organs for human transplantation."

—*Jeremy Rifkin, The Biotech Century, 1998*

There are said to be 300 or more products of petroleum, each with its own use. Some of these products serve merely our convenience, such as the artificial 'vanilla' flavoring... others were found during the war period to be absolutely essential... for example, the heavy oil used in tempering steel plates."

—*George Otis Smith, "Where the World Gets Its Oil," National Geographic Magazine, February 1920*

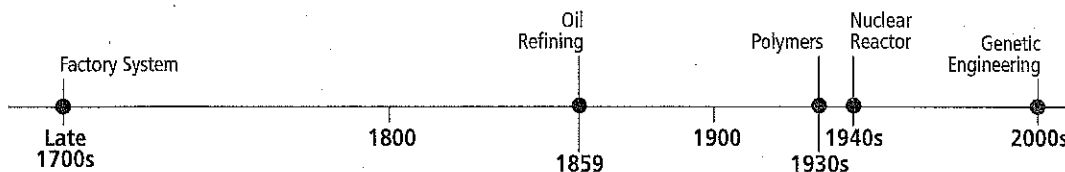
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"America in the year 2001 faces the most serious energy shortage since the oil embargoes of the 1970s... Many families face energy bills two to three times higher than they were a year ago. Millions of Americans find themselves dealing with rolling blackouts or brownouts; some employers must lay off workers or curtail production to absorb the rising cost of energy. Drivers across America are paying higher and higher gasoline prices... A fundamental imbalance between supply and demand defines our nation's energy crisis."

—*National Energy Policy, May 2001*

[E]ven low levels of radiation may result in the later development of cancer, genetic defects, or birth defects among children who are exposed in the womb."

—*Report of the President's Commission on the Accident at Three Mile Island, 1979*



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**Directions:** Read the excerpts regarding the issue of technology and society. Using your knowledge of history and the information from the excerpts, list some of the advantages and disadvantages of technological progress in the table below. If you need more space, recreate the table on a separate sheet of paper.

	Advantages	Disadvantages
Factories		
Oil		
Nuclear power		
Genetic engineering		

**Directions:** After you have completed the table above, answer the following questions on a separate sheet of paper.

1. Why was the Lowell mill so noisy and hot?
2. What effects of an energy shortage does the National Energy Policy identify?
3. What hazard does the report on the accident at Three Mile Island point out?
4. **Apply Information** What are some other uses of petroleum not listed in the National Geographic article?
5. **Analyze** What do you think the National Energy Policy means by an imbalance between supply and demand?
6. **Link Past and Present** The United States faces an impending energy crisis within the next century. Given what you have learned, do you think that nuclear power presents a viable alternative? Explain your answer, considering the benefits and risks of nuclear energy.
7. **Explain Problems** Why do you think people might object to the cloning of plants and animals for medical and other purposes?
8. **Identify Alternatives** Research other energy or fuel alternatives to oil and nuclear power. On a separate sheet of paper, recreate the table above and list the advantages and disadvantages for two of the alternatives that you identify.