1.3 Science and Technology and the Environment

The impact of human activity on the natural environment was first seen in the late 1700s with the start of the Industrial Revolution. The industrial age had an immense impact on the environment, with dramatic changes to the land, the oceans, the forests, and the atmosphere. The development of iron-making techniques, the manufacture of machinery, the introduction of steam power, and the extensive use of coal as a fuel marked the beginning of a period of increased industrial production. Technology became a tool by which humans could dominate and exploit Earth's resources. Many of the industries that arose from this period rely on natural resources such as minerals, wood, fish, and farm products. The harvesting of these resources and their use in industry have direct impacts on the environment.

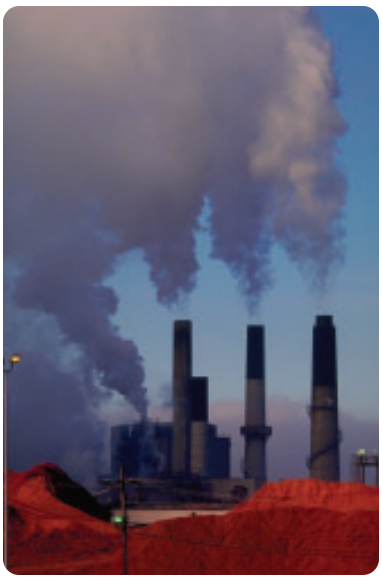

Figure 1 The burning of fossil fuels and the use of natural resources create environmental pollutants.

Since the Industrial Revolution, the industrialized world has continued to use resources at an alarming rate. The growing population and society's demand for more goods and services have resulted in industrial and household wastes that pollute the land and water. With the use of resources, the development of technology, and the human population all increasing, wastes are being produced faster than they can be recycled or reduced to harmless substances. Many of the by-products of human industry and technology become pollutants. For example, dioxins, released in the pulp and paper industry, are known to cause cancer and birth defects in laboratory animals. The burning of coal and other fossil fuels produces air pollution and, as you will learn in Chapter 16, contributes to the increasing level of greenhouse gases in the atmosphere—an accepted cause of climate change due to global warming (Figure 1).

Industrialized society did not use the traditional ecological knowledge of Aboriginal societies who understood that, to ensure survival, people have to live as part of the environment and manage it properly. The hunter who kills all of the game within the area has to relocate to survive, as does the farmer who does not properly maintain the soil. Today, we see the impact that decades of industrial development have had on the environment, and in recent decades we have realized that we cannot survive on an abused and polluted planet.

Modern technology enables, and sometimes requires, increased use of Earth's renewable resources, often at a rate faster than they can be replenished. For example, in many locations around the world, a renewable resource—fish—is being used up faster than it can replenish itself. Improvements in fishing technology (vessels, fishing gear, navigation, sonar) have increased the ability to find and catch fish, and the world's fish stocks are being depleted. Because technology has provided the capability, we have been overfishing with little regard for the future. Overfishing simply means

LEARNING TIP

Visuals such as the photographs in this section help you to make more accurate predictions. Survey the visuals. What issues do you predict will be addressed?

that we are catching so many adult fish that not enough remain to breed and replenish the population (Figure 2). Overfishing is disastrous not only for the environment, but also for the people and communities that rely on the fishing industry for food and income.

The collapse of the cod fishery off Newfoundland and Labrador is an example of what can result from overfishing. This led to a decision by the government of Canada in 1992 to close the commercial fishery on the Grand Banks (Figure 3). The stocks have improved somewhat since the closure, but a fishery is still not permitted. Despite the fragile condition of the stocks, vessels from other countries are still fishing the nose and tail of the Grand Banks and the Flemish Cap, which lies just outside Canada's jurisdiction.

Figure 2 Technology has allowed us to catch fish at a rate greater than the stocks are able to reproduce.

Figure 3 About a third of the fishing area of the Grand Banks lies outside the area managed by Canada.

The impact of science and technology on the environment is not always negative. New knowledge improves our understanding of the natural world, and new technologies that allow us to use the environment in a more sustainable way are being developed. For example, new energy technologies are available that can harness the energy of the Sun, the wind, or the tides. These technologies are much more environmentally friendly than the use of fossil fuels as a source of electrical energy. Alternative sources of energy are also being researched in the development of vehicles that have less of an impact on the environment and that are more fuel efficient.

Innovations are being devised to help us cope with environmental problems associated with growing populations and global warming. The world's wetlands—home to thousands of bird and animal species—are being lost to development and to rising sea levels. Bruce Kania of Montana, USA has developed a new method for constructing artificial floating islands out of recycled plastic and foam.

The construction starts with layers of polymer mesh held together by adhesive foam. Sod and vegetation are then added. Finally, plants are selected to attract insects, frogs, birds, beavers, and other wildlife (Figure 4). Once established, these artificial islands function like natural wetlands, providing a home for many organisms and filtering harmful substances from the water. As with most new technologies, artificial wetlands are expensive—approximately US$500 million per square kilometre of floating island.

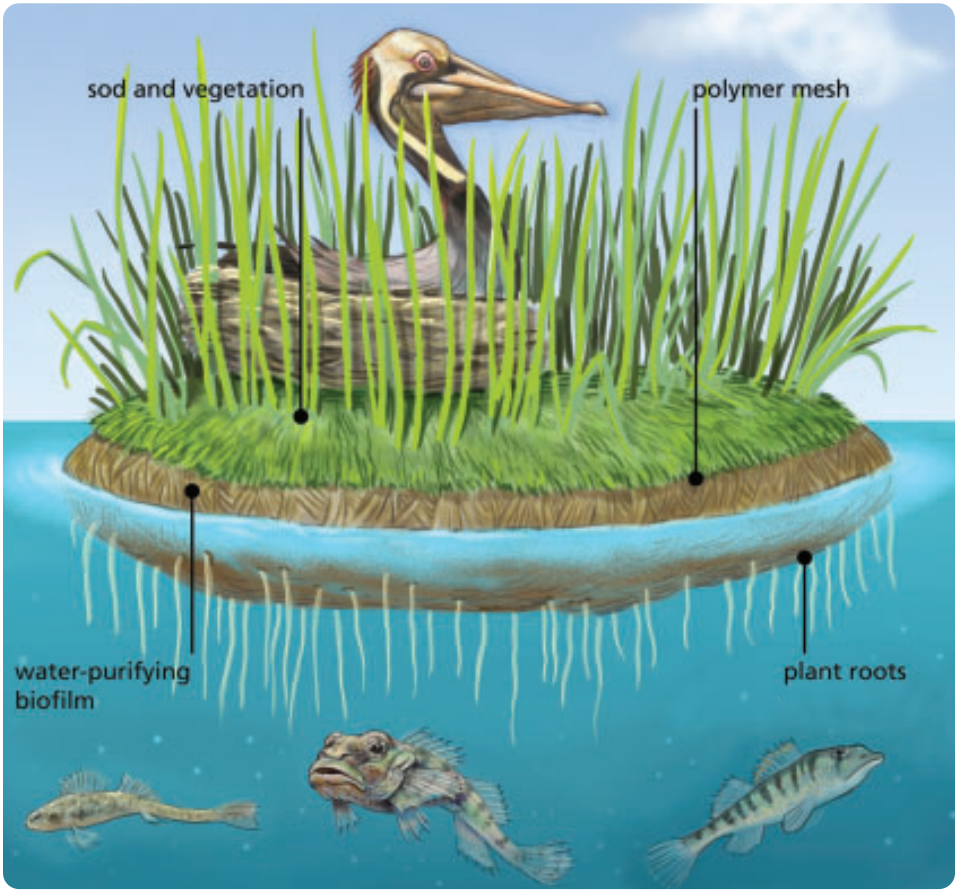

Figure 4 Synthetic wetlands serve the same purposes as natural wetlands, and are now being used in areas where natural wetlands no longer exist.

Another innovation that has been applied to solve an environmental problem is the use of special blankets to prevent the melting of glaciers. The top of the Gurschen glacier on Gemsstock Mountain in the Swiss Alps has receded by about 20 m in the last 15 years. A ski resort in Switzerland that relies on the glacier has attempted to prevent further melting by covering the glacier in blankets (Figure 5). The blankets are composed of polyester and propylene layers, and are pure white in colour. The blankets are used during the summer months to protect the snow cover from heat and UV radiation, which helps to minimize melting. However, this is not a practical solution to the global problem of melting glaciers. The blankets are expensive (approximately US$5 million per square kilometre), and it would be practically impossible to install blankets over all glaciers during the summer months and remove them again during the winter.

Figure 5 The protection of glaciers during the summer is an innovative use of thermal blankets.

The Importance of Scientific and Technological Literacy

We live in a time when growing scientific knowledge and rapid technological innovations are playing an increasingly significant role in everyday life. Science and technology have become so common and prevalent in our society that often we do not see them, or we take them for granted. Most people do not attempt to understand new technologies because they are designed so that the average person can use them without having to understand how they work. Science is often perceived as too complex to be understood by the average person.

Carl Sagan, a renowned astronomer and author, recognized the role of science and technology and the importance of being scientifically and technologically literate when he said in his book *The Demon-Haunted World*

> We've arranged a global civilization in which the most crucial elements profoundly depend on science and technology. We have also arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power will blow up in our faces.

To make wise personal decisions and to act as a responsible citizen, it is necessary to be scientifically and technologically literate. **Scientific and technological literacy** can be thought of as a combination of the science-related attitudes, skills, and knowledge needed to develop inquiry, problem-solving, and decision-making abilities.

A scientifically and technologically literate person understands first of all that the future will be very different from the present because there are always new developments in science and technology. Such a person also understands that society influences science and technology as much as science and technology influence society. We each have a responsibility to ourselves, to society, and to future generations to aim for scientific and technological literacy.

Because science and technology influence our lives so profoundly, it is important that we recognize and understand this influence so that we can make rational decisions about which scientific and technological research we support. We, as a part of society, need to consider both the positive and negative impacts of developing and using scientific knowledge and new technologies. Although we cannot foresee all of the possible consequences of new scientific and technological achievements, a society that does not consider both the positive and the negative implications of proposed new technologies may understand the consequences of that decision only after the technology has been adopted.

STUDY TIP

Having notes, study cards, and past exams organized and handy will help you prepare for a chapter exam. An effective organization system is to put all your notes, cards, and past exams for each chapter in a three-ring binder.