17

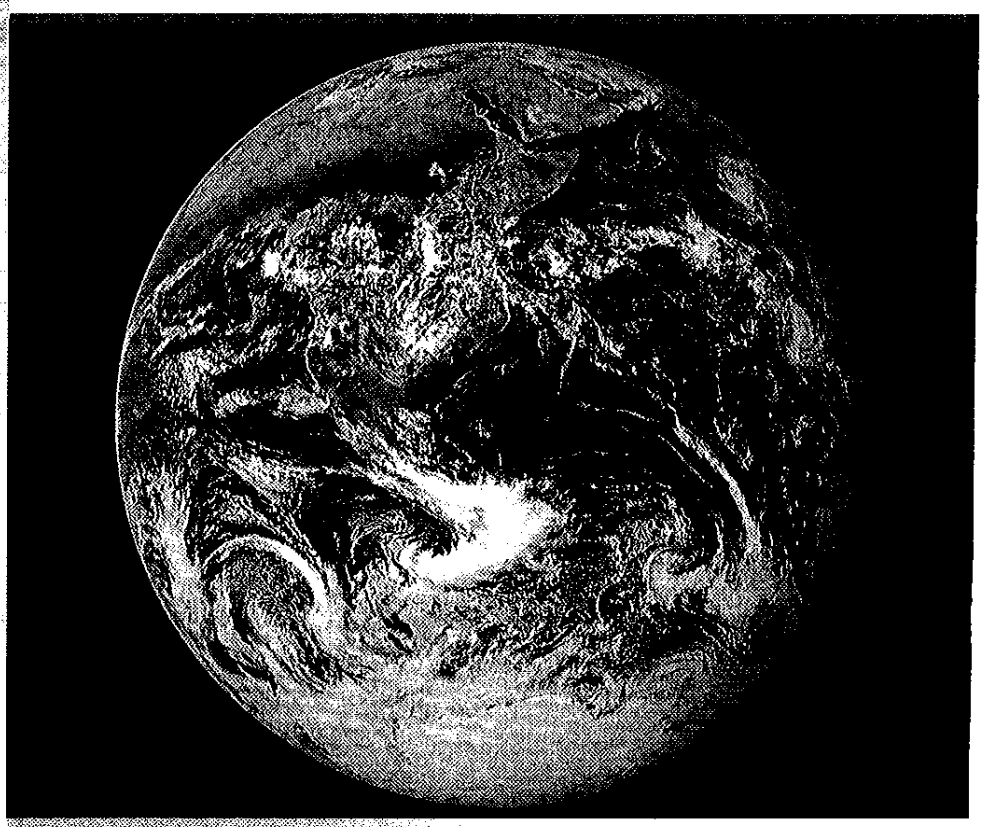
Environment

FOCUS ON

- What are the principal international agreements concerning the environment?
- What is the concept of sustainability?
- How are resources, environment, and human populations interconnected?
- What are the environmental threats to water, air, soil, and forests in Canada and the world?
- How can we offset environmental threats at the local, national, and international levels?

Counterpoints Issue

- Should Canada treat water as a resource to be traded?



The moon landing in 1969 was a landmark event. For the first time, we saw our planet from another place in the cosmos. Earth appeared as a beautiful blue sphere alone in the vastness of space. For the first time, we could see for ourselves the limits of our world, a "spaceship" itself with its own life support systems. This was coupled with a realization that all parts of ecological systems are interconnected and affect the whole.

Expressing ideas Brainstorm a list of the ways in which your community is linked to the rest of the world. For instance, check where your clothes or other possessions are made. How many parts of the world can you list? Explain whether this does or does not make you feel a part of a global community.

Introduction

The Earth's resources, environment, and human populations are interconnected. People use the resources for energy and raw materials to sustain life and to create wealth. These activities have an impact on the natural and human-built environments. For example, agriculture has disrupted the natural systems of the Earth from the time it was first practised.

As the world's population has increased, the scale of human impact has grown. For example, in 1950, the harvest of fish from the world's oceans was nineteen million tonnes, rising to nearly ninety million tonnes by the end of the twentieth century. The same impact can be shown with water, soil, forests, minerals, and energy resources. We have caused harmful changes in the **biosphere**—the zone of earth, water, and air in which we live. It is from this thin zone that our livelihoods come, and it is back to it that all things, including people, return. In this chapter, we examine some of the changes in our environment, and look at some of the solutions that are being proposed for the problems these changes are creating.

Population and Resources

Each year nearly eighty million people are added to the world's population, putting ever more pressure on the Earth's natural systems. Yet much of the increase is in the developing world, so the impact is not as great as if it had occurred in the developed world. Nearly 85 per cent of the world's resources are being consumed by 20 per cent of the world's population, mainly in the industrialized Western countries (see Figure 14-5, page 344). If even a fraction of the increase in population in the developing world lived like most people in the industrialized world, pollution and waste levels could overwhelm the Earth's natural systems.

Sustainable Development

In 1992, 1700 concerned scientists from around the globe signed the World Scientists' Warning to Humanity:

> Human beings and the natural [environment] are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about....
>
> WARNING—We the undersigned, senior members of the world's scientific community,

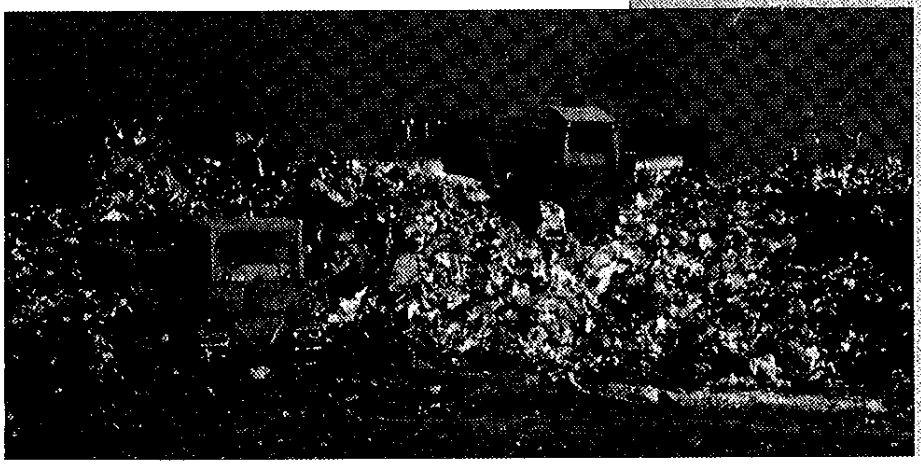


Figure 17-1 A landfill site in Ontario.

Using evidence Canadian society is a "consumer" society. How does this photograph illustrate that description?

> hereby warn all humanity of what lies ahead. A great change in our stewardship of the Earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated.

This concern is not new in Western society. Since 1962, when Rachel Carson published *Silent Spring*, there have been many international meetings that have discussed how to maintain economic growth without damaging the environment so much that it compromises the future of life on the planet. This concept is known as *sustainability*. The term came into common use following the findings of the United Nations Commission on the State of the Environment, also known as the Brundtland Commission.

In 1987, the Commission's report, *Our Common Future*, asked for people in the developed world to reduce resource consumption and develop a sustainable lifestyle. Economic development "must meet the needs of the present without compromising the ability of future generations to meet their own needs." The report said that the developing world would need to reduce population growth to allow for development that would not overwhelm the environment. The developed world would need to practise greater stewardship of renewable and non-renewable resources to ensure the needs of future generations and to reduce the impact on the environment. Canadians have looked to governments to take action. To date, our governments and international agreements have generally failed to live up to the challenge.

In 1992, the largest gathering of heads of state in human history met at the Earth Summit in Rio de Janeiro, Brazil, to look at ways of harmonizing economic growth and a safe environment. The conference produced a statement of action, called **Agenda 21**, to encourage the development of a sustainable world economy. Nearly a decade later, there has been little progress in slowing the environmental trends seen at Rio as a threat to the well-being of the planet.

Figure 17-2 The Dalai Lama, the Tibetan spiritual leader, gives a speech at the 1992 Earth Summit in Rio de Janeiro, urging world leaders to cooperate for the good of the environment.

ACTIVITIES

1. Define biosphere, sustainability, Agenda 21.
2. Write three different headlines, each one summarizing one of the concerns in the World Scientists' Warning to Humanity.
3. What did the Brundtland Commission call for the developed and the developing worlds to do about the problems facing the Earth?
4. Which countries or areas of the developed and developing worlds might most concern scientists worried about the consequences of:
   a) population growth?
   b) resource use?

Water Deficits in Selected Countries and Regions

Country/Region	Estimated Annual Water Deficit (billion m³ per year)
India	104.0
China	30.0
United States	13.6
North Africa	10.0

Source: Global Water Policy Project and Worldwatch Institute

Figure 17-4 A water deficit is a measure of how much more groundwater is being used than is being replaced. As the table indicates, the countries with the largest deficits are the two most populous countries in the world.

Thinking critically What are the long-term implications for India and China of these deficits?

Water: The Indispensable Resource

People cannot survive without water. Every person requires at least five litres of fresh water each day for good health. Many economic activities, particularly agriculture, rely on a regular supply of water. Yet, its value is often underrated. Many nations, particularly in the developed world, waste or pollute water resources.

Only 3 per cent of the water in the world is fresh water. Nearly 78 per cent of that is in the form of ice caps and glaciers, and much of the remaining amount is underground as **groundwater**. While there is enough water to supply the world's population into the future, the problem—as with many of the world's resources—is its uneven distribution. In Canada, we have a large share of the world's fresh water. The Great Lakes alone contain 18 per cent of all the surface fresh water on Earth.

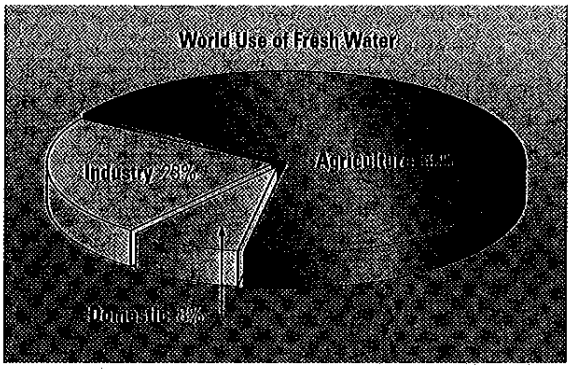


Figure 17-3 The demand for fresh water grew by 400 per cent in the latter half of the twentieth century.

Gathering information What is the main use of fresh water? Which parts of the world rely on irrigation for agricultural purposes?

Abusing an Underground Resource

Increasing populations are the main threat to the world's freshwater supply. Falling groundwater tables and diversion of surface supplies are the main causes of shortages. The Yellow River in China, the Ganges River in India, the Nile River in Africa, and the Colorado River in the United States are examples of rivers that run dry, or have little water left when they reach the sea. These shortages threaten world agricultural production. Forty per cent of the world's harvests comes from irrigated croplands. The United States, China, and India are all facing reduced groundwater supplies. These countries produce half the world's food.

In the latter half of the twentieth century, the amount of irrigated land more than doubled to over 250 million hectares. Using new technologies and techniques in well-drilling, farmers were able to tap the groundwater in **aquifers** beneath their land. Unlike erratic river flows or rainwater, the supply of groundwater is constant and can be pumped whenever the farmer needs it, and is cheaper to access than surface water. It does not need to be stored in costly reservoirs and is not subject to the high rates of evaporation found in hot, arid, or semi-arid lands. The problem is that, unlike surface supplies, aquifers do not recharge rapidly. The water in the aquifer comes from water slowly seeping into the surface through porous rocks such as sandstone or limestone. These are called *permeable* rocks. Sometimes the water in the aquifer is trapped between layers of *impermeable* rock, which does not allow water to seep through. The water table is the top of the saturated layer. There can be serious environmental and health consequences if the water table is allowed to fall too low.

Farmers in China, India, and the United States are witnessing the consequences of years of overpumping of groundwater sources. In India and China, groundwater was the fastest-growing source of irrigation water in the last quarter of the twentieth century. In the North China Plain, where most of that country's food is produced, the water table is falling by 1.5 m per year. Farmers are forced to drill deeper wells costing more money or to return to farming that relies on seasonal rains, which means lower crop yields. In India, water

building your skills

Identifying Causes and Effects

Identifying causes and effects is an important skill that requires critical thinking. Sometimes it is too easy to "jump to a conclusion." A cause-and-effect sequence that appears to be straightforward at first glance can be much more complicated upon closer examination. You need to separate those causes that are clearly linked to the effect from those that are only marginal or have no connection. Your analysis should also distinguish between short- and long-term effects. A diagram or chart can be a good way to show the sequence of causes and effects.

Read the description below and decide on the causes and effects.

"Safe" Water and Sick People

In some areas of India, as wells are dug ever deeper in search of water, they tap into minerals such as arsenic and fluoride. These minerals affect the health of the people who use the water.

In the village of Hirapur, in the central state of Madhya Pradesh, the ill effects of wells put in to provide safe drinking water have begun to be noticed. During the United Nations International Water Decade of the 1980s, the Indian government was sinking up to 60 000 boreholes a year and analysing water from only a tenth of them. The rich mineral deposits of the area meant that the groundwater contained natural chemicals such as fluoride. The crippling effects of fluorosis (bone damage caused by high concentrations of fluoride in water) have made it difficult for people with deformed limbs to work or get to school. "The problem is enormous, unbelievable; in some villages, three-quarters of the population is seriously affected," says Andezhath Susheela of the Fluorosis Research and Rural Development Foundation in New Delhi. She estimates the number of people leading a painful and crippling life from fluorosis to be as high as sixty million, six million of them children. UNICEF and other agencies are testing water for fluorides and other chemicals, and geologists are mapping areas with safer sources of water. In the meantime, people continue to use the sources of water available, whether contaminated or not.

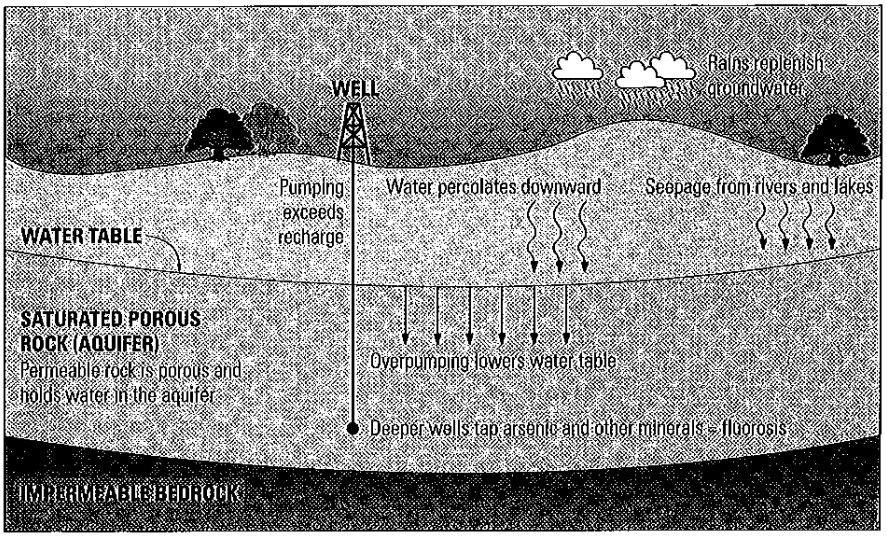


Figure 17-5 Groundwater depletion. Overpumping with diesel- and electric-powered pumps mines the water faster than it can be recharged by rains or seepage from surface sources. The falling water table means wells must be dug deeper.

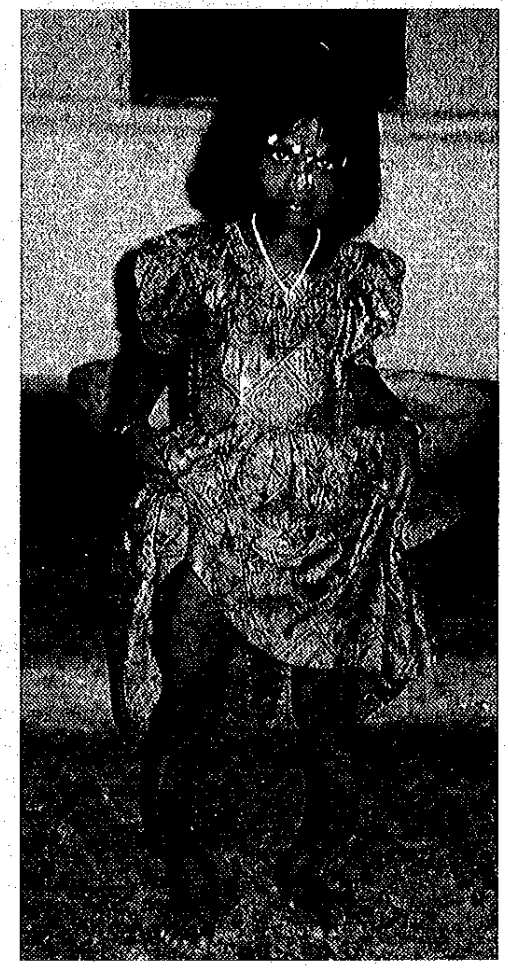
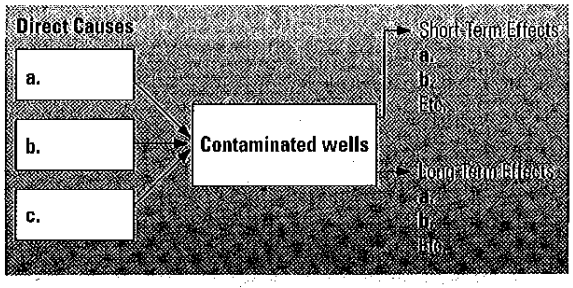


Figure 17-6 Fourteen-year-old Krishna suffers from the effects of fluorosis. She cannot walk to school because her legs are so bowed.

Developing understanding What other problems might Krishna face, now and in the future, as a result of her condition?

Applying the Skill

1. Copy and complete the flowchart below, using information from the description to fill in the principal causes and effects of the contaminated wells in India.



2. What other information would you want to know to be sure that the information in your chart is correct, and that you are not "jumping to conclusions"?
3. Complete a cause-and-effect chart for one of the other issues in this chapter, such as soil erosion, desertification, or global warming.

CASE STUDY

The Ogallala Aquifer

The United States faces difficulties as a result of groundwater depletion. The Ogallala aquifer is one of the world's largest sources of underground water. This huge underground reservoir underlies the Great Plains of the United States from just south of the Canadian border to Texas. It provides water for more than one-fifth of the irrigated land in the United States. Filled over thousands of years by runoff from the Rocky Mountains, it has taken a little more than half a century to reduce the aquifer by over half its volume. The U.S. federal government adds to the problem by allowing farmers to claim the depletion of groundwater on their income tax, giving them little incentive to conserve the resource.

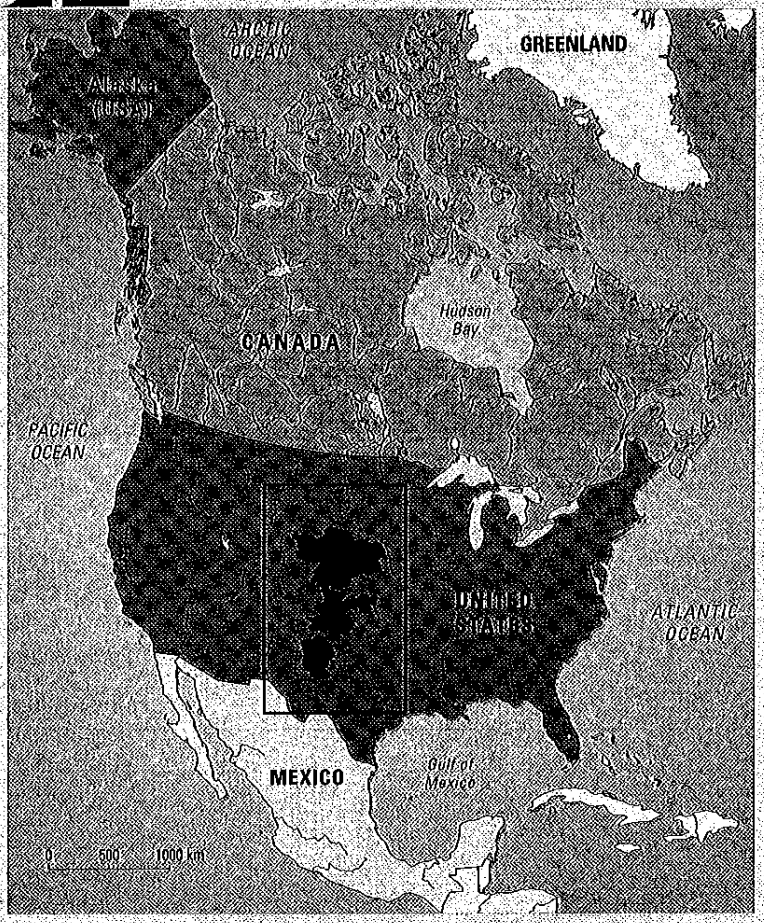


Figure 17-7 The Ogallala aquifer.

tables are falling by one to three metres per year, and wells are running dry. Aquifer depletion could reduce India's harvest by one-fourth. With dwindling groundwater supplies, India will become more dependent on imported grain.

Abusing Surface Water

Surface waters—such as lakes, rivers, and coastal waters—are also being abused. They have been used for disposal of sewage and agricultural and industrial wastes. Tanker accidents and natural causes account for some of the pollution. But most pollution originates from municipal, agricultural, and industrial sources. Municipal wastewater may contain human effluents, detergents, and solvents. Farmers use agricultural chemicals in herbicides and pesticides. Industries such as oil refineries, pulp mills, and chemical factories discharge wastes into rivers and oceans. The effects of pollution in world oceans are confined mainly to coastal areas and enclosed waters that do not have the circulation of open oceans and seas (see Figure 17-18, page 434). Even whales and polar bears in Arctic regions have shown signs of toxic wastes, such as mercury, in their systems.

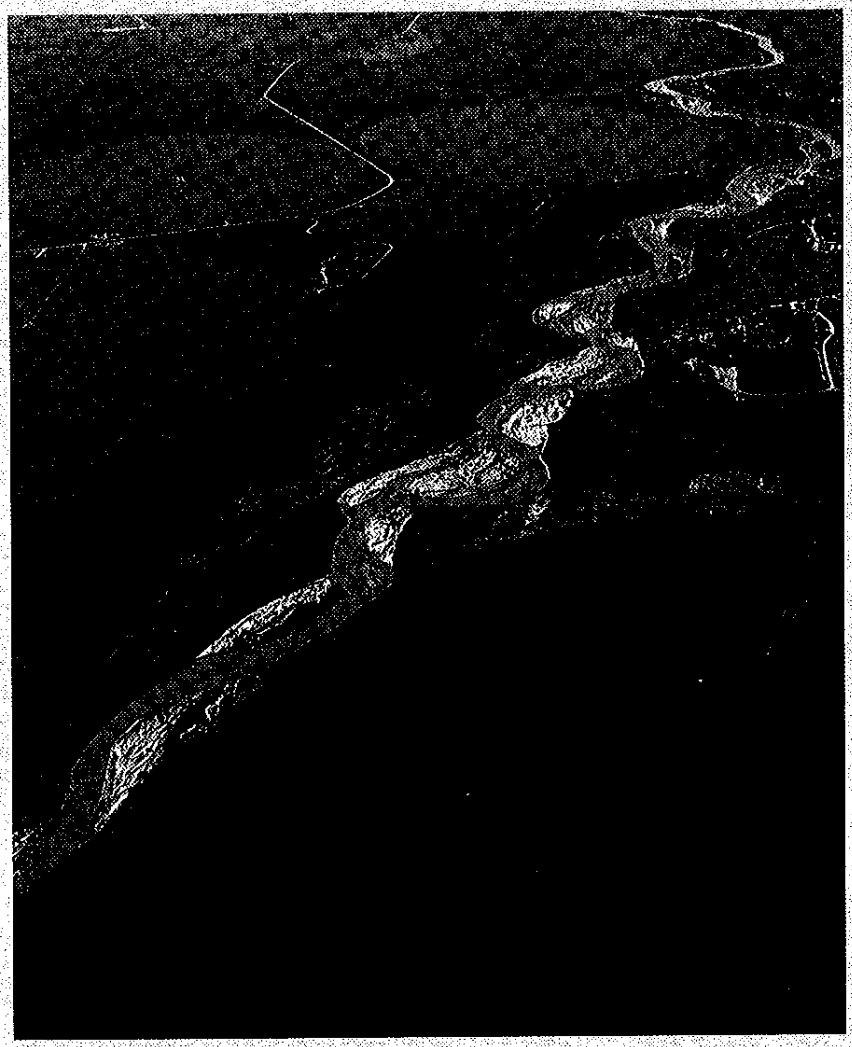


Figure 17-8 The Arkansas River cuts through the irrigated fields of western Kansas. Irrigation, above all other uses, places the biggest demand on the Ogallala aquifer in western Kansas. The river is almost the only surface water in that part of the state.

Questions

1. What is the Ogallala aquifer, and why should its depletion be of concern to Canadians?
2. Prepare a pamphlet for farmers who use water for irrigation from the Ogallala reservoir. Explain sustainable development and what farmers must take into account to ensure that they use the water resource in a sustainable way.

Many of the world's great rivers and lakes, such as the Thames in England and Lake Baikal in Russia, were so badly polluted by industrial and chemical waste that they could no longer support life. Life has returned to the Thames as a result of strict environmental controls. Waterways in the USSR were badly polluted during the communist regime; since its fall, the economic crisis has made the cleanup of lakes and rivers a low priority.

On Canada's east and west coasts, Victoria and Halifax dump untreated wastes into surrounding waters. Beluga whales in the St. Lawrence River and sturgeon in the Fraser River are threatened by waters polluted by industrial, agricultural, and human wastes. Interior pulp mills provide 50 per cent of the industrial discharge in the Fraser River; 90 per cent of the municipal waste in the river originates in the Fraser Valley and Vancouver areas. In Canadian lakes near populated areas, agricultural and industrial chemicals and wastes promote the growth of algae and weeds that deplete the lakes' oxygen supply for life forms and affect recreational use. In British Columbia's Okanagan lakes, it is a constant battle to prevent the spread of milfoil weed, which threatens a multimillion-dollar tourist industry.

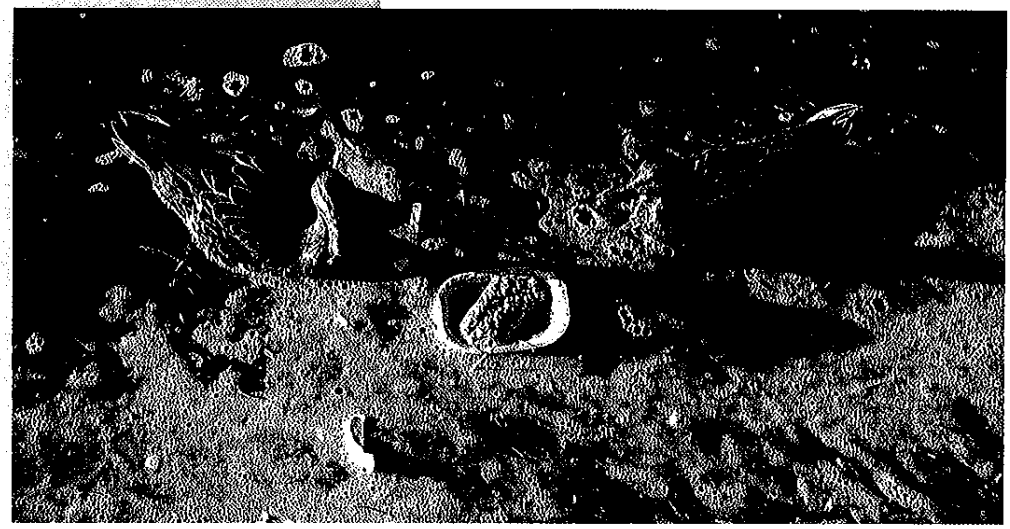


Figure 17-9
Ducks swim among garbage here in the polluted waters of the Fraser River.

counterpoints

Should Canada Treat Water As a Resource to Be Traded?

Water Exports: Drinking Canada Dry

As world freshwater shortages grow, business people from Vancouver Island to Newfoundland have been quick to suggest ways to take advantage of Canada's abundant supply of pure water. In 1995, the British Columbia government banned the export of bulk water and was sued by a California company under the North American Free Trade Agreement (NAFTA) for compensation for lost opportunity. The Ontario government was forced by public outcry to cancel permission to export Lake Superior water to Asia. In Newfoundland, a plan to export lake water to the United States and the Middle East raised questions about Canada's water export policies.

Some Canadians argue that Canada's fresh water should be treated like other resources and be exported for gain. They point out that the revenues and jobs created in areas of high unemployment, such as Newfoundland, would justify the export policy. Others, however, claim that water is in a different category. Maude Barlow of the Council of Canadians, a nationalist lobby group, strongly opposes exports, claiming: "Once you turn on the tap, you can't turn it off again." Nationalists claim that under the terms of NAFTA, if any bulk water is exported, all water will then be treated as any other trade good. Canada would lose control of its water.

Some water experts think that the whole issue of bulk water exports is overblown. They claim that transporting bulk water over long distances may not be profitable. A report to the Quebec government pointed out that desalination plants could turn salt water into fresh water for less than the cost of transporting it long distances by tanker. U.S. studies show that conservation methods such as low-flush toilets and drip irrigation make far better economic sense than massive water import schemes. However, rich countries like the United States and Canada do not always adopt the obvious or low-cost solutions to resource issues. Political pressure from southwestern sun-belt states for a quick solution to water shortages, and Quebec's reluctance to agree to federal policies, could also affect the outcome.

Few Canadians pay attention to the export of bottled water. These exports have been growing steadily, in particular to the United States. Canadian per capita consumption of bottled water is one-quarter that of the average U.S. consumption. A study by the International Joint Commission, a Canada–U.S. body that oversees water resources shared by the two countries, found that Canada is the biggest supplier of bottled water to

Solutions

The trend in water development programs is to conservation and efficient small-scale supply systems. U.S. environmentalist Dr. Peter Gleick, in his book *The World's Water: Biennial Report on Freshwater Resources, 1998–1999*, is optimistic in his belief that sustainable water management can be realized with present technology. Large-scale projects can be replaced by micro-dams, hydro systems that run with a river's natural flow, shallow wells, and more efficient rainwater harvesting. As technologies develop, he sees an increase in the use of reclaimed or recycled water and, to a lesser degree, of desalinated seawater. Low-energy sprinkler systems and drip irrigation, which directs water to plant roots, are used extensively in water-scarce Israel, and could be used in agriculture worldwide.

In industrialized countries, industrial and domestic use can be reduced using the same thinking. For example, new toilet design has led to high efficiency and low flow, reducing by 70 per cent the amount of water needed to flush millions of toilets.

Canada, the United States, and India have no national policies to regulate the use of groundwater. Taxes or user rates could be introduced to encourage users to conserve water.

the United States, where the market is growing at over 10 per cent a year. The low cost of the Canadian dollar, close access to the market, and the perception of many Americans that Canada has an unspoiled environment, have all favoured Canadian exporters.

Province	Volume (litres)	Share (%)
Quebec	246 558 496	90.7
Ontario	16 710 533	6.1
British Columbia	7 679 841	2.8
New Brunswick	474 160	0.2
Alberta	258 127	0.1

Source: International Joint Commission Report, cited in "Bottled water gushing south," *Globe and Mail*, September 22, 1999

Figure 17-10 Bottled water exports to the United States in 1998 for selected provinces.

Canadian provinces have issued licences to businesses for the extraction of thirty billion litres of water a year from Canada's springs, lakes, icebergs, and aquifers. British Columbia is the only province that charges a fee for the use of the resource, which brings only $25 000 a year in revenue. In British Columbia, licences are granted for life. Heather Smart, a water policy expert at the B.C. Environment Ministry, claimed in 1999 that "this is a problem right across Canada, that water is undervalued." Water bottling companies point to the jobs they create and the taxes they pay. They would agree to pay user fees if all other users of groundwater had to do the same. Environmentalists claim that a fee based on market worth would give the provinces needed revenue. They also note that the extraction of water over a period of time could affect an area's water table.

What is certain in the issue of water exports is that shortages will increase, putting added pressure on Canadian export policies. The basic question remains to be answered: Is water a special resource to be treated differently from other resources?

Analysing the Issue

1. What changes, if any, would you make in government regulation of the bottled water industry in Canada?
2. Do you agree with Heather Smart's opinion that fresh water in Canada is undervalued? Give examples to support your opinion.
3. Why might Quebec be opposed to regulation of the export of water supplies?
4. With a partner, script and act out a short dialogue between a Canadian opponent of water exports and a Texas farmer whose wells are running dry.
5. Do you think Canada should allow the export of bottled water? Bulk water? Both bottled and bulk water? Or no water? Give reasons for your answer.
6. Write a 200-word opinion piece that could be featured on an Internet site, entitled "Three Good Reasons to (or Not to) Export Canada's Water." Include a suggestion for an appropriate picture to accompany your opinion piece.

ACTIVITIES

1. Do you agree that increasing populations are the main threat to the world's freshwater supply? Explain your answer.
2. In a two-column organizer, list the benefits and problems associated with groundwater use.
3. Which of Dr. Gleick's solutions to water management do you consider to be the most practical? Explain your choice.
4. Make a list of some of the sources of water pollution in your community. Find out what action is being taken to deal with the worst examples of pollution.
5. Do you think provincial governments in Canada should have regulations governing groundwater use? Why or why not?

Change Is in the Air

The Hole in the Ozone Layer

The ozone layer is a thin layer of ozone (O_3), a special kind of oxygen, in the atmosphere 15–50 km above the Earth's surface. Ozone is the only gas in the atmosphere that can block the ultraviolet (UV) rays of the sun. UV radiation can cause skin cancer in humans, and can damage other animal and plant species. Plankton—microscopic organisms that are at the bottom of the marine food chain—are particularly vulnerable, as UV radiation can penetrate up to 20 m below the ocean surface.

In the 1980s, it became apparent that the ozone layer was thinning. Ozone depletion is most evident at the northern and southern poles where holes open in the layer, especially in the spring. As much as 60 per cent of the layer has disappeared over Antarctica.

Chemicals, particularly chlorofluorocarbons (CFCs), which have done 80 per cent of the damage, are destroying the ozone layer. CFCs have been widely used since the 1930s in coolants for refrigerators and air conditioners, in foams, solvents, and aerosol spray cans. The United Nations Environmental Program (UNEP) has been working on phasing out the use of ozone-depleting chemicals. In 1987, all industrial nations agreed to

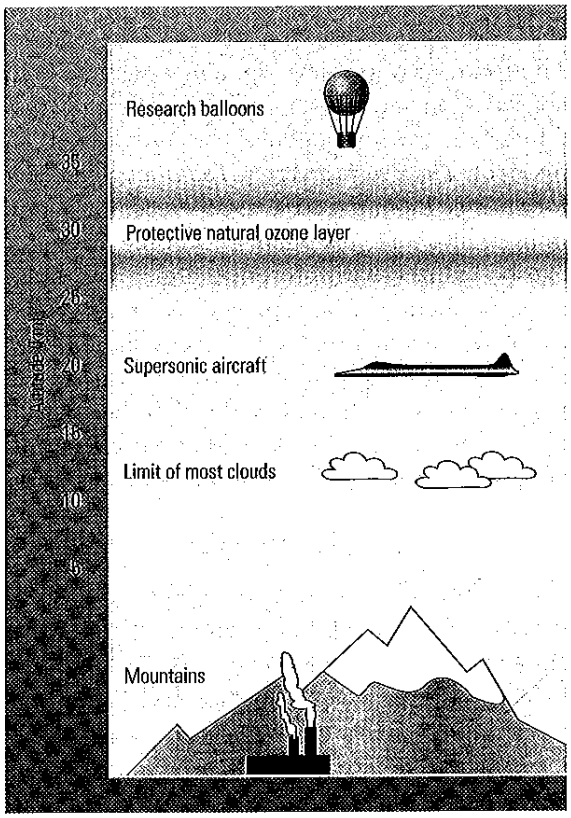


Figure 17-11 The ozone layer.

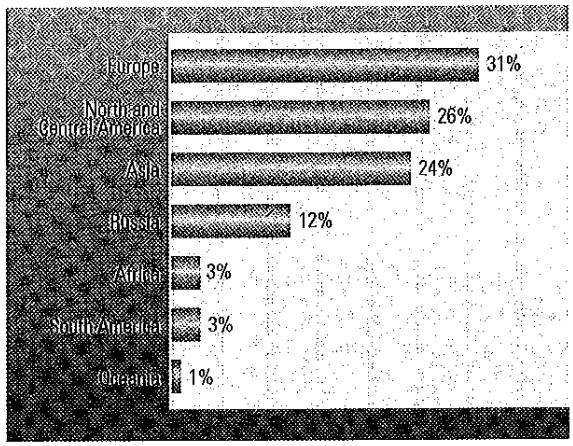


Figure 17-12 Emissions of CFCs (percentage of world total).

Reading a graph What was the combined percentage of CFCs emitted by Europe, North and Central America, and Russia?

cut their use of CFCs in an agreement known as the Montreal Protocol. The Protocol allowed countries of the developing world to use CFCs until 2000, as substitutes are expensive. Meanwhile, the amounts of these chemicals released into the air are increasing.

Only the complete elimination of CFCs and the recapture of those already in use will begin to halt the damage to the ozone layer. The U.S. Environmental Protection Agency claims that even if all ozone-depleting chemicals are phased out, it could take a century for conditions in the atmosphere to return to what they were in the 1980s.

Things Are Warming Up

The gases in the atmosphere trap the heat energy from the sun like glass in a greenhouse. They make it possible for life on Earth to exist. Natural factors, such as volcanic explosions and meteor impacts, have caused vast climatic changes in the past. Since the Industrial Revolution and the subsequent massive burning of fossil fuels—coal, oil,

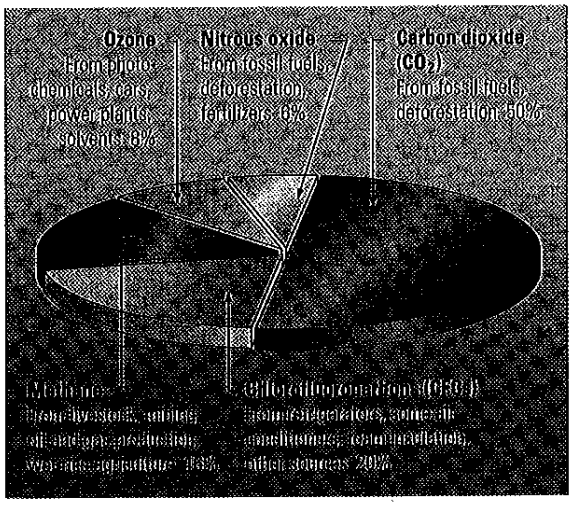
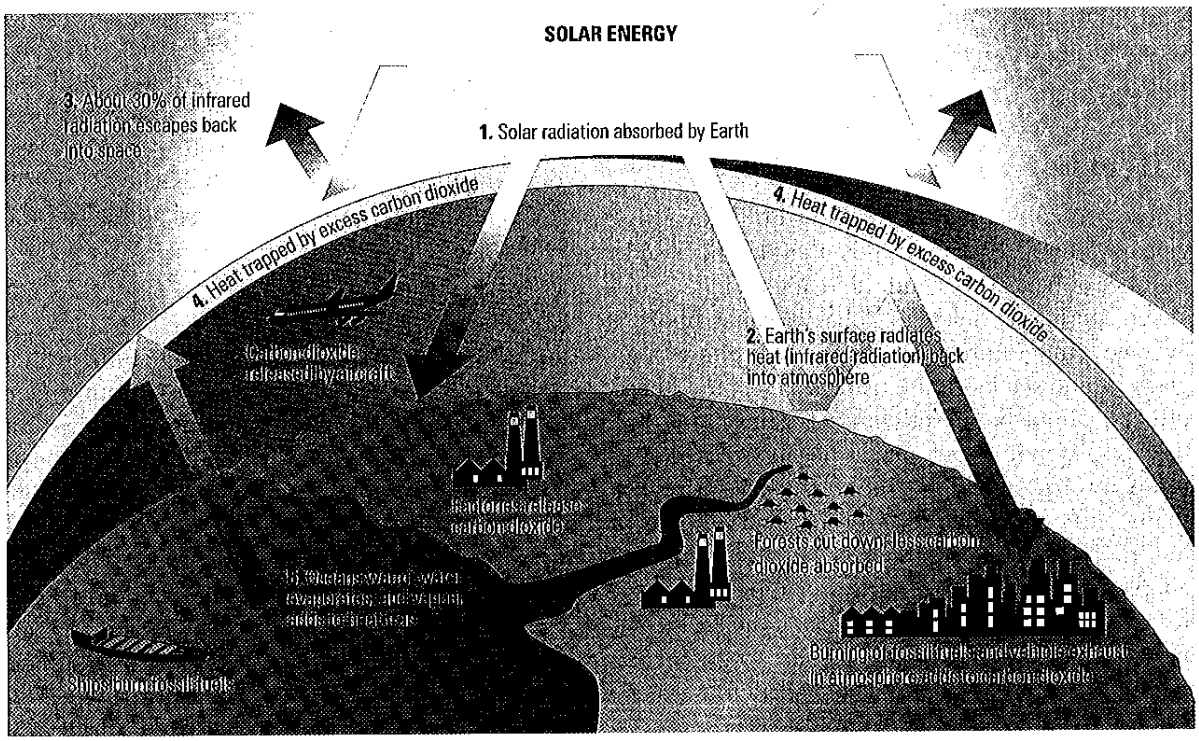


Figure 17-13 The greenhouse gases that contribute to global warming.

Reading a graph Which are the two main greenhouse gases? What percentage of greenhouse gases comes from burning fossil fuels and deforestation?

Figure 17-14 How the greenhouse effect works. Excess carbon dioxide accumulations trap heat that would otherwise be radiated back into space.



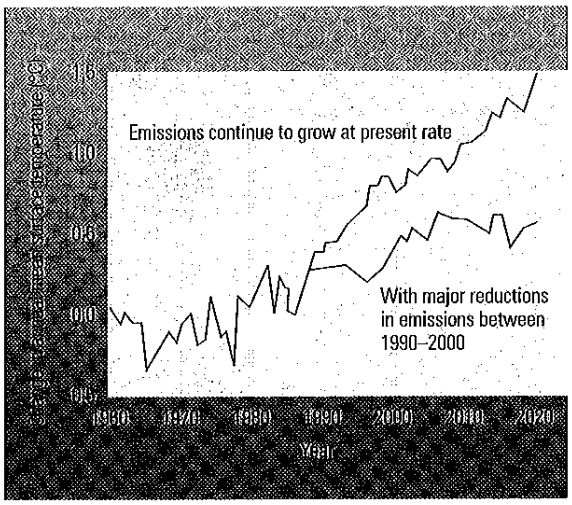


Figure 17-15 Predicted temperature changes due to the greenhouse effect.

Reading a graph What is the least amount of change that is predicted for 2010? What is the maximum?

and natural gas—scientists have detected much more carbon dioxide (CO_2) in the atmosphere. This could cause the temperature to rise by an additional one to three degrees Celsius by the year 2050. Even minor increases in the Earth's temperature can have profound effects on life on Earth.

Effects of Global Warming

There are consequences to the trends towards global warming. Scientists agree that the increased number of heat waves and the rising incidence of violent storms are linked to global warming. Above-average temperatures in polar regions are melting glaciers, and sea levels are rising as a result. Other effects cannot be directly linked. These include diseases extending their ranges because of warmer temperatures, and the earlier arrival of spring in many parts of the world. Shifting plant and animal ranges have been observed as species try to adapt to changing temperatures by moving to different habitats. Coral reefs are losing their colours in over thirty countries as the microscopic algae that give them these colours fail to adapt to warmer water temperatures.

Threats to Canada

It can be difficult to convince Canadians that rising temperatures are a problem. Yet in Canada's Arctic regions, the sea ice is shrinking and the seasonal melt is occurring weeks earlier than in previous years. Polar bears are slowly starving because they cannot use the ice to hunt seals. Since the 1980s, the bears' birth rate and average weight have fallen. Arctic communities are facing sinking shorelines as a result of the melting of **permafrost**, the permanently frozen subsoil.

The survival rate of spawning salmon in British Columbia is one-third of what it was in the early 1990s. Warmer ocean waters may have depleted the phytoplankton that salmon feed on, resulting in smaller fish that can't survive the swim upstream to spawn. Scientists also warn of the ripple effect of shrinking salmon stocks on the ocean food chain and the economies of coastal fishing communities.

Winter recreation and skiing areas close to populated areas in central Canada could be devastated by warmer winters. Freak weather conditions, such as the ice storm that devastated eastern Ontario and Quebec in January 1998, are more likely.

Warmer weather brings more droughts that make forest fires more likely. A benefit may be that the tree line could be extended farther north and higher up mountains. Global warming could also lengthen Canada's short growing season, helping farmers. This benefit could be offset by increased drought in prairie areas, such as the semi-arid Palliser Triangle in southern Saskatchewan and Alberta.

Doing Something About It

In 1997, Canada was among the countries that agreed to sign the **Kyoto Protocol**, promising to reduce greenhouse gas emissions by 6 per cent of our 1990 level by 2012. Countries not meeting their reduction targets could buy credits from other countries, likely less developed, that had emissions below their allotted levels.

Canada is among the top global emitters of greenhouse gases. Despite modest reduction targets, greenhouse gases emitted in Canada have continued to increase. In the 1990s, the fossil-fuel industry campaigned against the Kyoto

The Kyoto Commitment

Year	Greenhouse Emissions	Per Cent Increase/ Decrease Since 1990
1990	601 million tonnes	*
1997	682 million tonnes	+13.5
2010	565 million tonnes	–6.0

*Base year for Kyoto Protocol reductions

Figure 17-16 Canada's actual greenhouse gas emissions for 1990 and 1997. The 2010 figure shows the emission levels that Canada agreed to at Kyoto. By 2000, Canada needed to reduce emissions by approximately 27 per cent to achieve this target.

Protocol standards. They claimed that meeting them would involve high costs and possible loss of jobs. Another problem is that the federal government signed the agreement, but provincial governments must regulate polluting industries. Reports in 2000 listing Ontario as North America's second-worst polluter support the claims of critics that the Ontario government has not taken the issue of global warming seriously.

There are many sustainable sources of energy that could be used to lessen dependence on fossil fuels. These include wind turbines, solar power panels, tidal power, ground-source energy or geothermal power, which uses heat from underground sources where available. The environmental group Greenpeace claims that within twenty years, wind power could provide 10 per cent of the world's electricity requirements. Although all these alternative sources of energy have drawbacks, they are without harmful emissions. The British Columbia company Ballard Power predicts that its hydrogen- or methanol-fuelled power cells will be in automobiles by the year 2003. The new, smaller fuel cells are adaptable for cars, buses, and other stationary uses in the home or in industry.

Can Canada make a difference? Canadians consume over forty times as much energy as people in developing countries, and our high standard of living means we consume resources at a much higher rate. Our small population can have as much impact on world energy and resources as a less developed country many times our size.

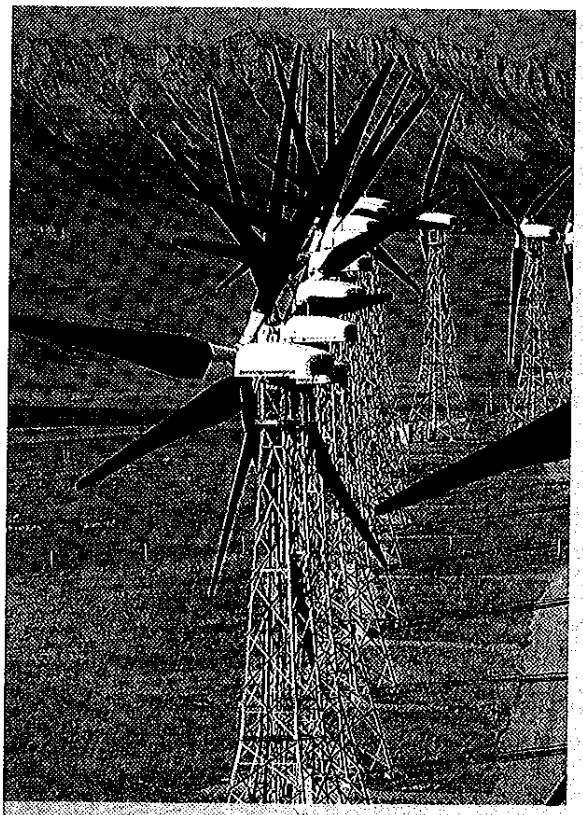


Figure 17-17 Wind turbines would be effective in windy locations such as along the coast of British Columbia or in the Alberta foothills, shown here.

Gathering information What would be the advantages and drawbacks to this form of energy?

ACTIVITIES

1. **a)** What is the ozone layer, and why is it thinning?
   b) Why is this a threat to life forms on the planet?
2. Suggest ways to convince the public to phase out ozone-depleting chemicals.
3. **a)** What is global warming?
   b) Use a mind map or an ideas web to organize the principal and secondary causes of global warming.
4. Describe a major threat that Canada faces from global warming. What solutions to global warming can be found in Canada?
5. Which forms of sustainable energy would be practical in your area? Support your choices.