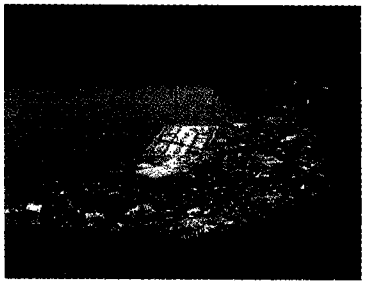
Pollution

6

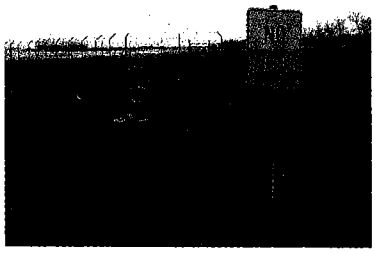
LEARNING OUTCOMES

- Air pollution
- Water pollution
- Soil pollution
- Noise pollution
- Setting personal goals and practicing methods of reducing pollution

(a)



(b)



(c)

Pollution

- Air pollution
- Water pollution
- Soil pollution
- Noise pollution

Figures (a) to (c) show the impact of various human activities on different natural resources. Look at these pictures carefully and try to answer the questions given below.

1. Can you guess which natural resources are being affected in each of these pictures?

   .....

2. Which human activities do you think are affecting these resources?

   .....

3. Is the impact of human activities on these resources likely to be beneficial or harmful?

   .....

The release of harmful substances, mostly resulting from human activities, into the environment is termed *pollution*. Pollution adversely affects natural resources such as air, water, and soil. A substance that causes pollution is termed a *pollutant*.

Note: We can also say that pollutants *contaminate* the environment. Contamination is the process of making a pure substance impure, infected, or corrupt.

Organisms, including humans, cannot thrive in a polluted environment. The pollutants accumulated in the environment over a period of time can be a serious threat to its inhabitants. In this chapter, we will discuss different kinds of pollution.

Pollution is mainly of four types: air pollution, water pollution, soil pollution, and noise pollution.

AIR POLLUTION

Air pollution is the presence of harmful substances in air, which adversely affect our health or cause other harmful environmental effects.

Sources Following are the chief sources of air pollution.

1. *Automobile exhaust* The exhaust fumes from automobiles contain nitrogen monoxide, carbon monoxide, hydrocarbons, lead, and carbon dioxide, some of which are highly poisonous.
2. *Industrial and domestic emissions* The burning of fossil fuels such as coal and oil results in the release of fumes and smoke containing large amounts of sulphur dioxide and solid particles (soot and dust). Hydrocarbons, carbon monoxide, carbon dioxide, and nitrogen oxides are also released.
3. *Atomic waste* The radioactive materials produced in an atomic blast also cause air pollution.

Effects Following are the main effects of air pollution.

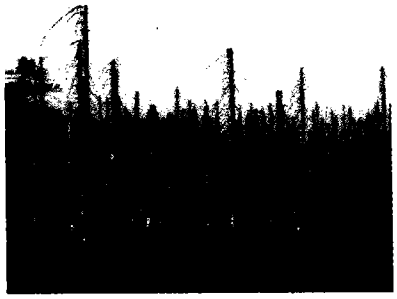
1. *Nitrogen monoxide* reacts with oxygen in the atmosphere and produces the highly toxic nitrogen dioxide, which damages the lining of the lungs and may cause bronchitis and cancer.
2. *Carbon monoxide* combines with haemoglobin in the blood and impairs or prevents the transport of the much needed oxygen to the brain and other parts of the body. This shortage of oxygen, if mild, causes headache and dizziness, but in extreme cases leads to convulsions, unconsciousness, and even death. These effects, arising from the presence of carbon monoxide in the body, are referred to as *carbon monoxide poisoning*

Major air pollutants

- Carbon monoxide *(reduces oxygen-carrying capacity of blood)*
- Sulphur dioxide and nitrogen dioxide *(contribute to acid rain)*
- Fly ash, asbestos, and hydrocarbons *(damage lungs)*
- Radioactive particles *(cause cancer/genetic defects)*

FACT FILE

Carbon monoxide poisoning produces symptoms such as depression, emotional disturbances, and hallucinations. Interestingly, several incidents associated with the so-called 'haunted houses' (such as strange visions and sounds and unexpected death of all inhabitants) can, in fact, be attributed to carbon monoxide poisoning!



(a)

(b)

Fig. 6.1 *Damage caused due to acid rain to (a) forests and (b) marble statues*

3. *Hydrocarbons* released as a result of burning fossil fuels undergo chemical reactions in the presence of nitrogen monoxide and sunlight, resulting in the formation of peroxyacetylnitrate (PAN) and formaldehyde. These pollutants cause watering of the eyes and damage to the lungs. Vegetation is also affected. Some hydrocarbons can even cause cancer.
4. *Lead* present in automobile exhaust can gradually accumulate in the body, causing lead poisoning. Lead poisoning affects the nervous system and the kidneys. The use of petrol containing lead compounds aggravates this problem.
5. *Sulphur dioxide*, a colourless acidic gas, is a major air pollutant in industrial cities where coal and oil are used in large quantities. Besides causing extensive damage to vegetation and reducing crop yields, it can adversely affect the health of humans and of livestock.
6. *Acid rain*, caused by the accumulation of sulphur dioxide in the atmosphere, damages forests and agricultural crops, besides adversely affecting aquatic life in streams and lakes. It can wear away or *corrode* stone work and metal fittings in building (particularly marble) (Fig. 6.1) and, thus, pose a threat to historical monuments such as the Taj Mahal. *Corrosion* is a process of eating into or wearing away gradually, especially by chemical action, by which materials are gradually destroyed over a period of time.
7. The solid particles emitted by factories, in the form of smoke, pose serious health hazards.
8. *Smog* is produced when smoke is mixed with fog. The smog forms a 'blanket', up to a few hundred feet above the ground, and prevents pollutants from escaping into the upper atmosphere. The pollutants trapped below the blanket of smog may reach abnormally high concentrations. Those who inhale this polluted air risk suffering from chronic diseases and even death. Such disasters have struck many industrial cities all over the world. Smog, at times, also disrupts road, rail, and air traffic by causing poor visibility.

FACT FILE

The word **smog** is derived from the words **sm**oke and **fog**. In December 1952, over 4000 Londoners lost their lives due to smog that lasted for almost a week.

9. The ozone layer, situated 30 km above the Earth's surface, protects us against lethal ultraviolet rays of the sun. Chemicals called chloroflurocarbons (CFCs) (used as propellants in aerosols, as refrigerants in refrigerators, and as coolants in air conditioners) damage the ozone layer.
10. Strontium 90 is a fission product released during nuclear tests. Absorbed by plants, it enters the food chain and gradually finds its way to human bodies, where it accumulates, particularly in bones and milk. Lactating mothers may pass it on to their babies through breast feeding. Strontium 90 damages the blood-forming centres in the bone marrow.

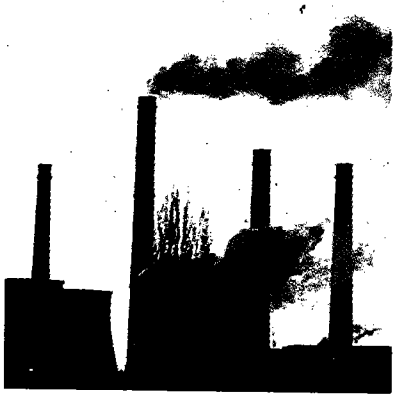


Fig. 6.2 *Tall chimneys help in the dispersal of pollutants*

Prevention A few steps that can be taken to prevent air pollution are listed below.

1. Pollution from automobiles can be prevented by adopting cleaner fuels such as CNG (compressed natural gas).
2. Use of car pools and public transport should be encouraged.
3. Unleaded petrol should be used in vehicles.
4. Use of tall chimneys in factories can help in dispersal of pollutants (Fig. 6.2).
5. Domestic garbage should not be burned in open.
6. Nuclear wastes should be disposed off safely.

FACT FILE

The Delhi Transport Corporation (DTC) operates the world's largest fleet of CNG buses.

WATER POLLUTION

The contamination of water with soluble substances, sewage, or industrial wastes (Fig. 6.3), which makes it unfit for living organisms is termed *water pollution.*

Sources Following are the chief sources of water pollution.

1. *Sewage* One of the major causes of pollution of water is the dumping of untreated or partially treated sewage from our towns and cities into the rivers.
2. *Fertilizers* Nitrates and phosphates (used in chemical fertilizers) are washed into rivers.
3. *Pesticides and herbicides* Chemicals used for pest control and weed control are washed into lakes, streams, and rivers, and ultimately into the oceans.

Fig. 6.3 *Industrial wastes are often dumped into water bodies*

Fig. 6.4 *An oil spill*

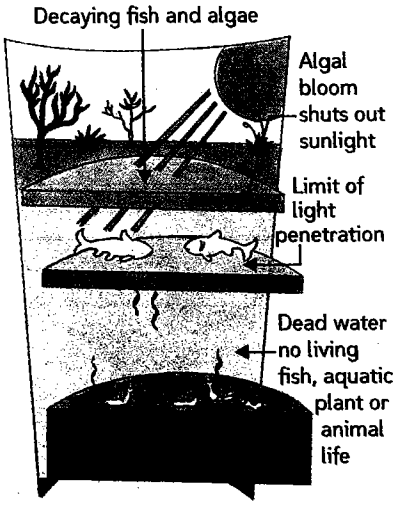


Fig. 6.5 *Effects of rapid growth or 'bloom' of algae in water bodies*

Fig. 6.6 *Pesticides being sprayed over a field*

4. *Industrial wastes*: Liquid chemicals discharged into water bodies by various industries also contribute to water pollution.
5. *Domestic wastes*: Objects such as metal cans, glass bottles, and plastic bags and containers are often dumped into water bodies.
6. *Oil spills*: Oil spills from tankers and oil rig blow-outs from drilling sites under the sea pollute the ocean (Fig. 6.4).

Effects Following are the main effects of water pollution.

1. When sewage enters a water body (such as a pond), micro-organisms decompose the organic materials present in it. The action of microorganisms depletes the oxygen dissolved in water. If the level of dissolved oxygen becomes too low, aquatic organisms may die. Another effect of pollution of water by sewage is that the disease-producing organisms may be carried downstream to a neighboring town.
2. Fertilizers washed into water bodies cause excessive growth of algae and set up a chain of events that ultimately exhausts the oxygen in the water, killing most animals and even the microorganisms which would otherwise have broken down these nutrients (Fig. 6.5).
3. Arial spraying of pesticides over vast stretches of orchards (Fig. 6.6) and machine or hand spraying in tea gardens and crop fields contribute greatly to the poisoning of the whole biosphere. These chemicals remain in the environment for long periods. Their concentrations build up as they pass from the environment into the organisms and from one organism into the other up the food chain, ultimately affecting human beings and other consumers at the top of the food chain. DDT sprayed to kill insects in the tropical countries has been found in high concentrations in penguins in the Antarctic! This clearly indicates that these chemicals can be a global threat to the biosphere. Realizing this, some countries (e.g. USA) have already banned the use of DDT.
4. Most industrial wastes are poisonous and cause death of aquatic organisms. The water becomes unsuitable for bathing and drinking. What is even worse is the fact that these wastes, even when discharged in small quantities, contain chemicals such as mercury, lead, cadmium, and asbestos, which, like

DDT, are cumulative poisons. These chemicals are absorbed by plankton, which are eaten by small fish, which in turn are eaten by bigger fish. At each stage, the concentration of these chemicals increase and may reach a lethal level by the time large fish are eaten by humans.

5. Metal cans, glass bottles, plastic containers, etc., are often thrown into water bodies. Glass and plastic articles are almost indestructible as they cannot be decomposed biologically. Hence these articles remain on the river bed, making it unsafe for swimmers and animals.
6. Oil spills result in death of birds and aquatic animals, besides leaving layers of encrusted oil along beaches.

TECH FILE

In 1973, 17 fishermen living along the coast of Minamata Bay died and 23 became permanently disabled, after consuming fish, crab, and shellfish contaminated with methyl mercury from Japanese Coastal industries. The deadly chemical had accumulated in the fatty tissue of fish.

Prevention A few steps that can be taken to prevent water pollution are listed below.

1. Liquid wastes (effluents) should be treated in special treatment plants, where they are rendered harmless before discharging them into the rivers.
2. Use of chemical pesticides should be minimized.
3. Metal cans, plastic bags, etc., should not be thrown in water bodies.

Note: Any activity that changes the physical or chemical composition of a hazardous waste, reducing its toxicity, is referred to as treatment.

SOIL POLLUTION

Soil pollution is contamination of soil (land) by solid waste.

Sources Following are the chief sources of soil pollution.

1. *Pesticides* Pesticides such as DDT and endrin not only kill the pests but also contaminates the soil.
2. *Agricultural waste* The agricultural sector is a large source of solid waste derived from plants and animals.
3. *Domestic waste* Household wastes such as fruit and vegetable peels, metal cans and objects, plastic bags and bottles, etc., litter the land and pollute the environment (Fig. 6.7).
4. *Mine refuse and slag heaps* The mining of coal and other minerals invariably produces large quantities of waste, and extraction of metals from their ores leaves behind large amounts of residual slag.

FACT FILE

Several stray animals die each year after accidentally eating polythene bags thrown in dustbins. About 4000 polythene bags were recovered from the stomach of a seriously ill stray cow.

Fig. 6.7 *Domestic waste*

THINK QUEST

Why are polythene bags considered harmful for the environment? (*Hint: If you buried a banana peel and a polythene bag, which one of them would decay?*)

Rachel Carson
(1907–1964)
American biologist Rachel Carson was one of the leading figures of the global environmental movement. She described the harmful effects of pesticides in her landmark book *Silent Spring*.

Effects Following are the main effects of soil pollution.

1. Pesticides, being stable compounds, persist in the environment for long periods. Organisms exposed to DDT absorb and accumulate it in their bodies and, as it travels up the food chain, its concentration increases. This is especially harmful for organisms at the top of the food chain.
2. Agricultural wastes become a breeding ground for many disease-causing organisms. They are gradually washed into the ground and later into water bodies, polluting them.
3. Foul-smelling garbage heaps not only destroy the beauty of the countryside but also provide breeding ground for disease-carrying flies, mosquitoes, and rats. Garbage can also contaminate the water supply.
4. Waste materials can be of two types: biodegradable or non-biodegradable. ***Biodegradable materials*** *are such materials that can be broken down by the action of living organisms.* Twigs and leaves are examples of such substances. Over a period of time, these substances are acted upon by a variety of organisms such as beetles, white ants, fungi, and bacteria and finally reduced to humus—a part of the soil that supports plant growth. ***Non-biodegradable*** *materials are those that cannot be broken down by the action of living organisms.* Glass and plastic are examples of such substances. Since these substances cannot be broken down by natural processes, their disposal becomes a problem.
5. The waste rock and slag are usually accumulated in heaps that occupy precious land. The chemicals in them are washed away by rain water and carried away into the streams, resulting in pollution of water bodies.

Name any five non-biodegradable materials.

1. .....
2. .....
3. .....
4. .....
5. .....

Prevention A few steps that can be taken to prevent soil pollution are listed below.

1. Plastic bags, old newspapers, glass bottles, etc., should be recycled and reused.
2. Solid waste should be buried in landfills rather than dumping it in open areas.
3. Organic wastes such as vegetable peels can be converted into manure by burying them in compost pits.

NOISE POLLUTION

Useless and unwanted sound is termed ***noise*** (Fig. 6.8). Noise can not only be disturbing but can also affect our hearing and hence is a pollutant. Sound level is measured in units called decibels. 1 decibel is the softest sound that a human being can hear. A whisper is 30 decibels, quiet conversation 60 decibels, nearby thunder 100 decibels, and rock and roll music 122 decibels. At 130 decibels sound becomes painful. Noise pollution is becoming a serious problem, particularly in cities where automobiles and aircraft (besides many other factors such as loudspeakers) are a constant source of noise. Prolonged exposure to sound between 85 and 115 decibels, as well as limited exposure to sound over 115 decibels, can create nervous tension, impair mental equilibrium, and can even cause loss of hearing. A very loud noise, such as that of a supersonic jet at close range, can rupture the eardrum and can even damage window panes of nearby buildings at landing sites.

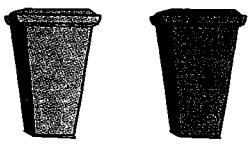
Fig. 6.8 *Noise pollution*

REDUCING POLLUTION: SETTING PERSONAL GOALS

By setting personal goals, every individual can play an important role in combating the problem of pollution. Our collective effort can greatly reduce pollution in our country. Some of the things you can do are listed below.

1. Avoid the use of polythene bags. Being non-biodegradable, they cause great harm to the environment. Instead, carry a cloth bag when you go shopping.
2. Think of ways to recycle waste materials, instead of throwing them away. For example, waste paper can be used to make bags and papier mâché goods.
3. Put waste materials such as packets of chips and candy wrappers in the dustbin.
4. Do not burn garbage. Composting is a better alternative and also gives you manure for your kitchen garden.
5. Do not play stereos, televisions, radios, etc., at loud volume. Firecrackers should also be avoided.

FACT FILE



In many cities, bins of two colours are used for separating biodegradable wastes from non-biodegradable ones. The biodegradable wastes are meant to be thrown in the green bin and the non-biodegradable ones in the blue bin.

KEYWORDS

Pollution The release of harmful substances, mostly resulting from human activities, into the environment
Pollutant A substance that causes pollution
Contamination The process of making a pure substance impure, infected, or corrupt
Biodegradable Materials that can be broken down by the action of living organisms
Non-biodegradable Materials that cannot be broken down by the action of living organisms
Noise Useless and unwanted sound

SUMMARY

- Pollution adversely affects natural resources such as air, water, and soil.
- Pollution is mainly of four types: air pollution, water pollution, soil pollution, and noise pollution.
- Automobile exhausts, industrial and domestic emissions, and atomic wastes are the chief sources of air pollution.
- Nitrogen oxides, carbon monoxide, hydrocarbons, and lead are some of the air pollutants.
- Sewage, fertilizers, pesticides and herbicides, industrial and domestic wastes, and oil spills are the chief sources of water pollution.
- Pesticides, agricultural wastes, domestic wastes, and mine refuse and slag heaps are the main sources of soil pollution.
- Harmful effects of noise pollution range from nervous tension to total loss of hearing.

EXERCISES

I. Review questions

A. Fill in the blanks

1. A substance that causes pollution is termed ..... (irritant/pollutant).
2. Carbon monoxide is an ..... (air/water) pollutant.
3. ..... (Leaded/Unleaded) petrol should be used in vehicles.
4. Use of ..... (short/tall) chimneys in factories can help in the dispersal of pollutants.
5. Glass and plastic are examples of ..... (biodegradable/non-biodegradable substances).

B. Tick the correct answer

1. Accumulation of sulphur dioxide in the atmosphere can cause
   (a) lead poisoning (b) acid rain (c) ozone hole (d) smog
2. Smog is produced when smoke mixes with
   (a) carbon dioxide (b) fog (c) rain (d) soil
3. Fertilizers washed into rivers can cause excessive growth of
   (a) fish (b) algae (c) fungi (d) all of these
4. Which of the following is a pesticide?
   (a) DDT (b) PAN (c) DPT (d) all of these

5. Which of the following damage the ozone layer?
   (a) DDT (b) carbon monoxide (c) CFCs (d) sewage

C. Correct the statements that are false

1. Carbon monoxide combines with haemoglobin in the blood.
2. Smog can disrupt traffic by causing poor visibility.
3. Useless and unwanted sound is termed music.
4. Liquid waste can be discharged into water bodies directly.
5. Solid waste should be burned.

D. Answer the following

1. Name the four main types of pollution.
2. What is air pollution? List any two sources of air pollution.
3. What is carbon monoxide poisoning?
4. Write full forms of PAN, CNG, and CFCs.
5. What causes smog? Describe its harmful effects in brief.
6. What is water pollution? List any two of its effects.
7. List any two ways in which water pollution can be prevented.
8. What is soil pollution? List any two of its effects.
9. Why is noise considered to be a pollutant?

II. Skill-based questions

E. What can be done to prevent the following?

(a) air pollution by automobiles
(b) air pollution by factories
(c) water pollution by industries
(d) soil pollution by metal cans and plastic bottles

F. Identify the following pollutants.

(a) Reacts with oxygen in the atmosphere, producing the highly toxic nitrogen dioxide

.....

(b) Undergo reactions in the presence of nitrogen monoxide and sunlight, forming PAN and formaldehyde

.....

(c) Causes acid rain

.....

(d) Cause excessive growth of algae in water bodies.

.....

(e) Damages nervous system and the kidneys. Use of petrol containing this pollutant aggravates the problem.

.....

(f) A pesticide that accumulates in the bodies of organisms. As it moves up the food chain, its concentration increases.

.....

III. Fun Time

Observe the following picture carefully. How many types of pollution can you identify in the picture?

PROJECT IDEAS

- The level of air pollution in different parts of the city can be measured by performing the following experiment.

Materials required: Ten-centimeter-long strips of thick white paper and petroleum jelly.

Procedure: Smear the paper strips with petroleum jelly and hang them at different locations (e.g., inside your house, outside the house, near a busy road, and in an industrial area). Collect the cards after a week. Depending on how dirty the cards have become, you can predict the level of air pollution in these locations. Write a report based on your findings.

- Students can design posters on the theme 'say no to plastics'.

TEACHER'S NOTES

- Students could be asked to suggest ways to keep pollution under check.
- A visit to a nearby water purification plant could be organized, if possible.