

**Notes**

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POLLUTION

You have already learnt about the environment and its components in the earlier lessons. You have also studied the importance of maintaining a life-supporting environment. However, the environment has undergone many changes over the period of time. Population explosion in recent times has resulted in a number of environmental problems. The population of India has crossed the figure of 2 billion and the world population is estimated to have touched the 7 billion mark. To meet the demands of food, housing and energy, environmental resources are being exploited at a fast pace. Over-exploitation of resources and human activities have resulted in many environmental problems, such as deforestation, destruction of wild life, air, water, land and noise pollution, diminishing fossil fuels (oil, coal and natural gas), concentration of pesticides in alarming proportions in the bodies of organisms, and depletion of ozone layer and global warming.

In this lesson, you will learn about various kinds of environmental pollutant, their causes, effects and control.



OBJECTIVES

After completing this lesson, you will be able to :

- *define pollution;*
- *list various types of pollution and mention their sources;*
- *describe effects of air, water and soil pollution on flora and fauna;*
- *describe methods of control of air, water and soil pollution;*
- *describe methods of nuclear and solid waste management*
- *describe the causes and effects of sound pollution;*
- *describe the causes and effects of radiation pollution;*
- *discuss rates of entry and translocation of pollutants in the human body.*

27.1 POLLUTION

We perform a number of daily activities such as bathing and washing of clothes with soaps and detergents. By doing so we add some chemical residue to water and

change its quality. This water may mix with the water in ponds and rivers due to ignorance and carelessness. Cooking of food by using firewood may release smoke in the air. Agricultural activities may dump fertilizers and pesticides in the environment. **The addition of unwanted substances in a concentration that has an adverse effect on organisms and environment, is called pollution.**

An undesirable change in the physical, chemical and biological characteristics of the environment especially air, water and land that may adversely affect human population and the wild life, industrial processes, cultural assets (building and monuments), is called **pollution**.

The agents that pollute the environment or cause pollution are called **pollutants**.



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27.2 TYPES OF POLLUTION

Depending upon the area or the part of environment affected, pollution may be of the following types :

- Air pollution
- Water pollution
- Land pollution
- Noise pollution

27.2.1 Air pollution

We all breathe in air, we can feel, and even smell the air and say whether it is fresh or stale. The pollution in air may not be noticed until we see smoke coming out from some source. All human activities from cooking at home to activities in highly mechanized industries contribute to air pollution.

27.2.1a Sources of air pollution

The sources of air pollution can be divided into two categories (i) natural, and (ii) human-made

(i) Natural sources

- (i) Ash from burning volcanoes, dust from storm, forest fires
- (ii) Pollen grains from flowers in air are natural sources of pollution

(ii) Anthropogenic (human-made) sources

- (i) Power stations using coal or crude oil release CO₂ in air
- (ii) Also furnaces using coal, cattle dung cakes, firewood, kerosene, etc.
- (iii) Steam engines used in railways, steamers, motor vehicles, etc. give out CO₂.
- (iv) So do Motor and internal combustion engines which run on petrol, diesel, kerosene. etc.



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- (v) Vegetable oils, kerosene, and coal as household fuels
- (vi) Sewers and domestic drains emanating foul gases
- (vii) Pesticide residues in air

Major air pollutants

Some major air pollutants are discussed here.

- **Carbon dioxide**

Carbon dioxide is one of the major gases which contributes towards air pollution. It is mainly produced during the combustion of fuel in factories, power stations, household etc. The increasing CO₂ in the atmosphere is likely to have the following effects:

- (i) **A rise in atmospheric temperature or global warming due to greenhouse effect. Also causes climate change.**
- (ii) **Reduced productivity of the marine ecosystem.** This is due to the fact that water in the oceans would be more acidic due to increased concentration of CO₂ in the air, which dissolves in the water.
- (iii) **Due to Global warming,** the increased surface temperature would cause **melting of continental and mountain glaciers** and thus would cause **flooding of coastal areas** of some countries.

- **Sulphur dioxide**

It is produced by the burning of coal in powerhouses and automobiles (car, trucks etc.). It causes **chlorosis** and **necrosis** of plants, irritation in eyes and injury to the respiratory tract (asthma, bronchitis) in humans responsible for discoloration and deterioration of buildings. High concentration of sulphur dioxide in the atmosphere dissolves in rain drops to form sulphuric acid which causes **acid rain**.

- **Carbon monoxide**

Carbon monoxide is produced as a result of incomplete combustion of fossil fuels like coal, petroleum and wood charcoal. Automobiles using diesel and petroleum are the major sources of carbon monoxide which gets added to the atmosphere. Carbon monoxide is more dangerous than carbon dioxide. It is a poisonous gas which causes respiratory problems. When it reaches the blood stream, it replaces oxygen due to its high affinity for haemoglobin. It also causes giddiness, headache and interferes with normal function of the heart.

- **Fluorides**

Upon heating,, rocks, soils and minerals that contain fluorides, give out hydrogen fluoride gas. This is an extremely toxic gas, which causes serious injury to livestock and cattle.

- **Oxides of nitrogen**

A few oxides of nitrogen, such as nitric oxide (NO), nitrous oxide (N₂O) and nitrogen dioxide (NO₂) are produced by natural processes as well as from thermal

power stations, factories, automobiles and aircrafts (due to burning of coal and petroleum). They reduce the oxygen carrying capacity of blood, may cause eye irritation and skin cancer in human beings.

Smog

Smog is a mixture of smoke, dust particles and small drops of fog. Smog may cause necrosis and develop a white coating on the leaves (silvering) of plants. In human beings and animals, it may cause asthma and allergies.

Aerosol spray propellants

Suspended fine particles in the air are known as aerosols. Aerosols contain chlorofluoro carbons (CFCs) and fluorocarbons used in refrigerants and aerosol cans. They cause depletion of the ozone layer.

Domestic air pollutants

Smoke from cigarettes, *biri*, cigar and other such objects using burning tobacco, burning of coal, firewood, cow dung cakes, kerosene oil and liquefied gases are major domestic pollutants. The common pollutant gases emitted during the domestic burning of coal, kerosene oil, firewood, cow dung cakes, etc. are carbon monoxide (CO), carbon dioxide (CO₂), sulphur dioxide (SO₂), etc. The pollution due to these pollutants causes suffocation, eye and lung diseases and low visibility.

27.2.1b Effects of air pollution

Major effects of air pollution on human health, plants and other animals is given in table 27.1.

Table 27.1: Some major air pollutants, their sources and effects

Pollutant	Source	Harmful effect
Carbon compounds (CO and CO ₂)	Automobile exhausts burning of wood and coal	<ul style="list-style-type: none"> ● Respiratory problems ● Green house effect global warming and climate change
Sulphur compounds (SO ₂ and H ₂ S)	power plants and refineries Volcanic eruptions	<ul style="list-style-type: none"> ● Respiratory problems in humans ● loss of chlorophyll in plants (chlorosis) ● Acid rain
Nitrogen Compound (NO and N ₂ O)	Motor vehicle exhaust, atmospheric reaction	<ul style="list-style-type: none"> ● Irritation in eyes and lungs ● Low productivity in plants ● Acid rain damages material (metals and stone)
Hydrocarbons (benzene, ethylene)	Automobiles and petroleum industries	<ul style="list-style-type: none"> ● Respiratory problem ● Cancer causing properties



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<p>SPM (Suspended Particulate matter) (Any Solid or liquid particles suspended in the air, (fly ash, dust, lead)</p> <p>Fibres (Cotton, wool)</p>	<p>Thermal power plants. construction activities, metallurgical processes and automobiles</p> <p>Textile and carpet weaving industries</p>	<ul style="list-style-type: none"> ● Poor visibility, breathing problems ● Lead interferes with the development of red blood cells and causes lung diseases and cancer ● Smog (smoke+fog) formation leads to poor visibility and aggravates asthma in patients ● Lung disorders
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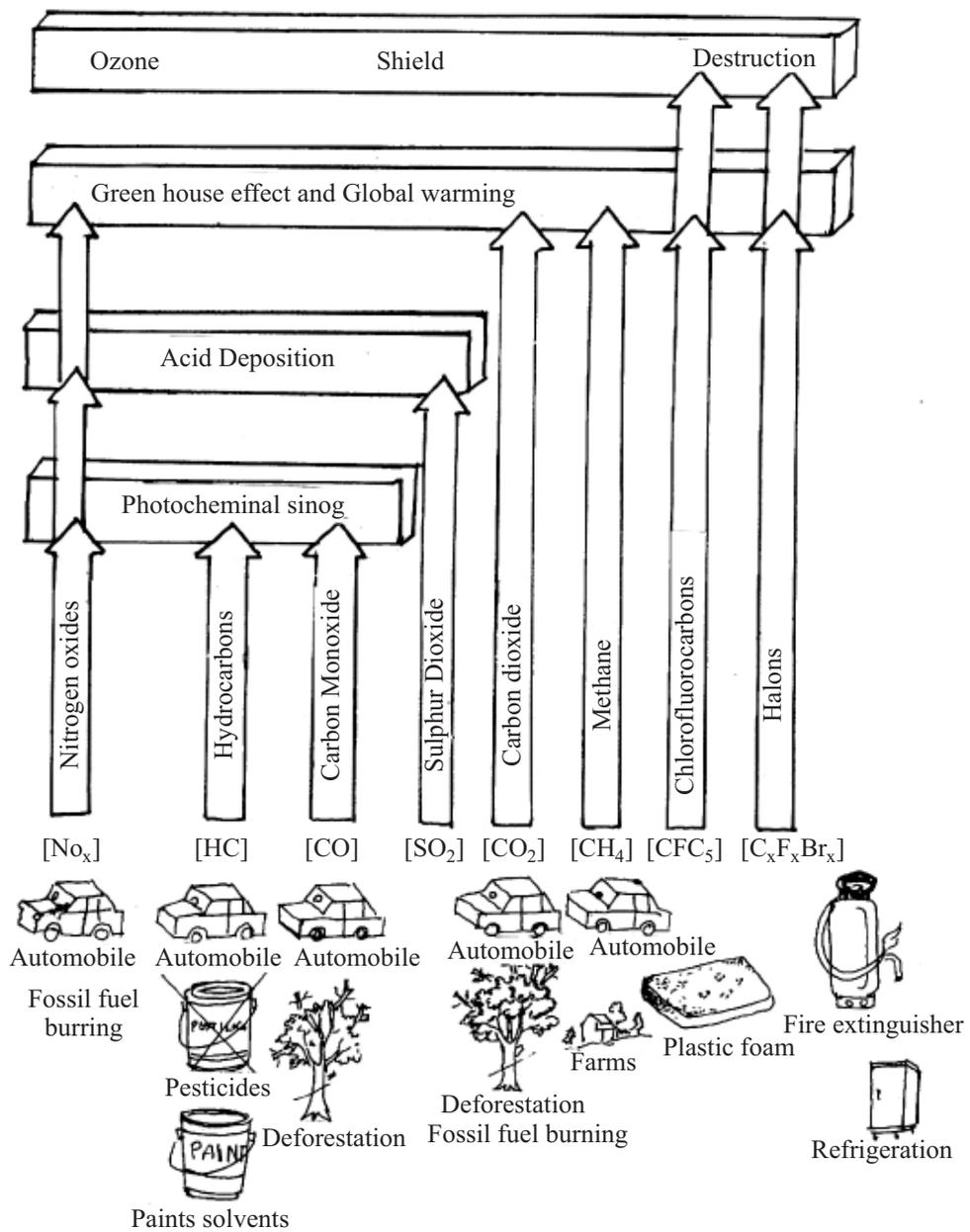


Fig. 27.1 Major effects of air pollution

27.2.1c Prevention and control of air pollution

There are two types of air pollutants—gaseous and particulate.

Methods of controlling gaseous air pollutants

- (i) **Combustion.** This technique is used for controlling those air pollutants that are in the form of organic gases or vapours. In this technique, the organic air pollutants are subjected to flame combustion technique (also known as catalytic combustion). In this technique, organic pollutants are converted into less harmful products and water vapour.
- (ii) **Absorption.** Absorption is a process in which a substance penetrates into another substance like scrubbers. In this technique, gaseous pollutants are passed through absorbing material like scrubbers. These scrubbers contain a liquid absorbent. This liquid absorbent removes the pollutants present in gaseous effluents. Thus the air coming into scrubber is free from pollutants and it is discharged into atmosphere.
- (iii) **Adsorption.** Adsorption is a process in which a substance sticks to the surface of another substance (called absorbent). In this technique, gaseous effluents are passed through porous solid absorbent kept in containers. The gaseous pollutants stick to the surface of the porous material and clean air passes through. The organic and inorganic constituents of gaseous effluents are trapped at the interface of solid adsorbent by physical adsorbent.

Methods to control particulate air pollutants

The particulate air pollutants such as dust, soot, fly ash etc. can be controlled by using fabric filters, electrostatic precipitators, wet scrubbers and mechanical devices etc.

- (i) **Fabric filters.** In this technique, gaseous emission containing dust, soot and fly ash is passed through porous fabric filters made of fabric (cloth) (woven or filled fabric). The particles of pollutants get trapped in this fabric and are collected in the filter and the gases free from the pollutant particles are discharged.
- (ii) **Mechanical devices.** There are many mechanical devices that clean the air of pollutants either due to (i) gravity in which the particles settle down by gravitational force; or by (ii) sudden change in the direction of gas flow in which particles separate out due to greater momentum.
- (iii) **Electrostatic precipitators.** In this technique, a gas or air stream containing aerosols in the form of dust, mist or fumes, is passed between the two electrodes of the electrostatic precipitator. During this process, the aerosol particles get precipitated on the electrodes.



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27.2.1d Prevention and control of air pollution

- (i) At domestic level, burning of wood and dung cakes can be replaced by use of cleaner fuel and biogas (formed by the decomposition of animal and plant wastes in a biogas plant).
- (ii) Automobile pollution can be reduced by :
 - pooling of transport or use of public transport.
 - use of unleaded petrol and CNG (Compressed Natural Gas).
 - regular tuning and servicing of the engines, and
 - switching off the engine at red lights or when not in use.
- (iii) Following measures can reduce industrial pollution:
 - installation of tall chimneys,
 - installation of devices that do not allow pollutants to be released in the environment, such as filters, electrostatic precipitators, scrubbers etc.,



INTEXT QUESTIONS 27.1

1. Define pollution.
.....
2. Name four types of pollution.
.....
3. Name one effect on plants and one on human caused by excess SO₂ in the air.
.....

27.2.2 Water pollution

Addition of undesirable substances in water is called **water pollution**. Water pollution could be due to natural or human activities.

Natural sources of water pollution are soil erosion, leaking of minerals from rocks, and decaying of organic matter, while **human-made sources** include domestic, agricultural and industrial activities. Many water sources have become a dumping ground for wastes. Water pollution is one of the main causes of human diseases in India.

Any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for desired use is called water pollution.

27.2.2a Sources of water pollution

There are two sources of water pollution on the basis of origin of pollutants:

- (i) point sources. and
- (ii) non-point sources.

- (i) **Point sources.** Those sources which discharge water pollutants directly into the water are known as point sources of water pollution. Oil wells situated near water bodies, factories, power plants, underground coal mines, etc. are point sources of water pollution.
- (ii) **Non-point sources.** Those sources which do not have any specific location for discharging pollutants, in the water body are known as non-point sources of water pollution. Run-offs from agricultural fields, lawns, gardens, construction sites, roads and streets are some non-point sources of water pollution.

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Water pollutants

River, lake and sea water may be polluted in many ways.

- **Domestic sewage** discharged into rivers from areas located on its banks
- **Industrial wastes** effluents from urban areas containing high concentration of oil, heavy metals and detergents
- **Minerals, organic wastes and crop dusting** from agricultural fields with phosphate and nitrogen fertilizers that reach lakes, rivers and sea (water becomes deoxygenated and poisonous, thus, cannot support aquatic life)
- **Chemical fertilizers, pesticides, insecticides, herbicides and plant remains**
- Industrial waste water containing several **chemical pollutants**, such as calcium, magnesium, chlorides, sulphide, carbonates, nitrates, nitrites, heavy metals and radioactive waste from nuclear reactor.
- **Excretory wastes of humans and animals in water bodies**
- **Disposal of urban and industrial waste matter into water bodies**

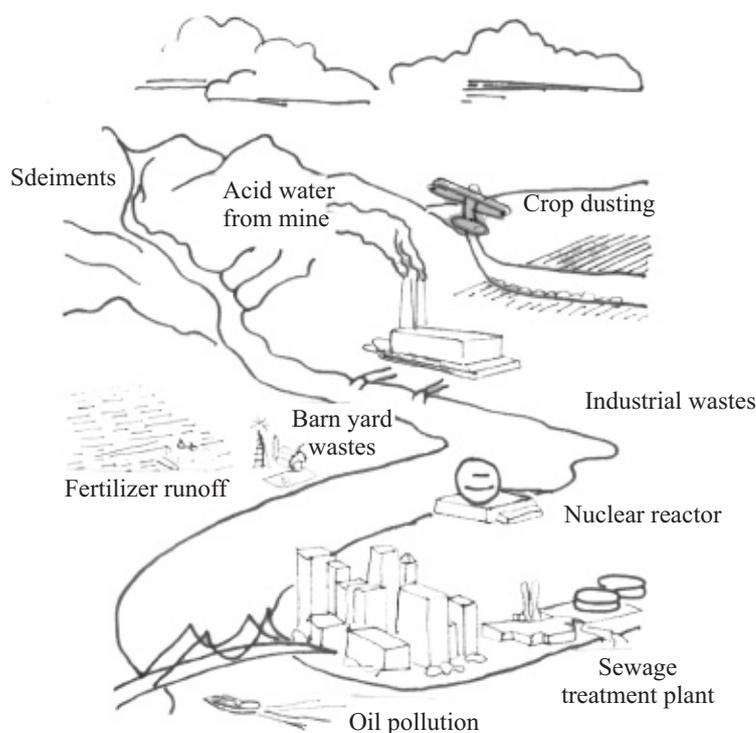


Fig. 27.2 Water pollution due to human activities.



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27.2.2b Effects of water pollution

- Water pollution **adversely affects the fish and other aquatic life.**
- The presence of acids/alkalis in water **destroys micro-organisms**, thereby disturbing the self purification process in rivers.
- The toxic materials in water **cause serious health hazards** in human beings and other animals.
- Polluted water causes **spread of epidemics**, such as cholera, tuberculosis, jaundice, dysentery, typhoid and diarrhoea in human beings.
- The use of polluted water from lakes, ponds and rivers for irrigation of agricultural fields, damages crops severely and **decreases agricultural production.**
- The use of water contaminated with salts **increases alkalinity of the soil.**
- Heavily polluted water **affects the soil, decreases its fertility** and kills soil micro-organisms and even certain useful bacteria.
- Contamination of sea water due to oil slicks caused by the leakage of crude oil from oil tankers causes **ecological disasters** which results in the death of sea organisms including fishes.

The sources and effects of certain water pollutants have been given in the following table 27.2

Table 27.2: Some major disturbances in the ecosystem due to water pollution

Pollutant	Sources	Cause	Effect
Nitrates, phosphates, ammonium salts	Agricultural fertilizers, sewage, manure	Plant nutrients	Eutrophication
Animal manure and plant residues	Sewage, paper mills, food processing wastes	Oxygen deficiency	Death of aquatic animals
Heat	Power plants and industrial cooling	Thermal discharge	Death of fish
Oil slick	Leakage from oil ships	Petroleum	Death of marine life due to non availability of oxygen dissolved in water

Fertilizers and pesticides are widely used in agriculture. Their excessive use for increasing agricultural yield has led to the phenomenon of **eutrophication** and **biomagnification**.



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Eutrophication

With the use of high yielding varieties of crops, the use of fertilizers and pesticides has increased a lot. Excess fertilizers may mix with surface water and may get drained into water bodies (surface runoff). The enrichment of water with nutrients such as nitrates and phosphates that triggers the growth of green algae is called **eutrophication**. (Fig. 27.3) This fast growth of algae followed by decomposition depletes the water body of its dissolved oxygen. As a result aquatic animals die of oxygen shortage.

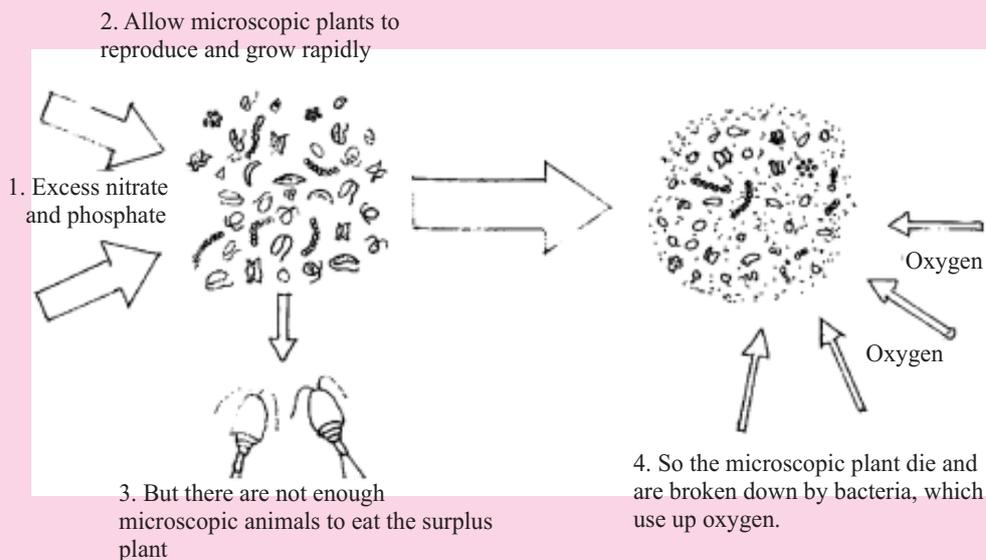
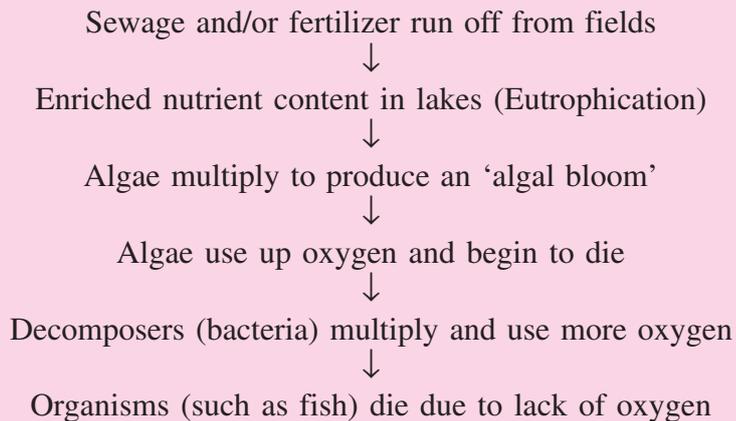


Fig 27.3 Sequence of events that may occur as a result of eutrophication

Biomagnification

Non-biodegradable pesticides, such as DDT are widely used for crop protection. Once they enter the food chain, their concentration keeps on increasing with each trophic level (steps of a food chain). As a result, accumulation of these compounds takes place in the body of top consumers over a period of time. Entry of harmful non-biodegradable chemicals in small concentrations and their accumulation in greater concentrations in the various levels of food chain is called **biomagnification**.



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Consider the following food chain. Is there any difference in the concentration of DDT in water and that in the body of the Pelican bird?

Water → Algae → Fish → Pelican bird (top consumer)
 0.2 ppm 77 ppm 500-600 ppm 1700 ppm

(ppm = parts per million)

DDT used in small quantities to kill mosquitoes can enter the food chain and may get concentrated in large concentration due to its non-biodegradable nature in the body of birds (top) consumer. This causes adverse effects, such as weak egg shells, resulting in decreased population. (Fig. 27.4).

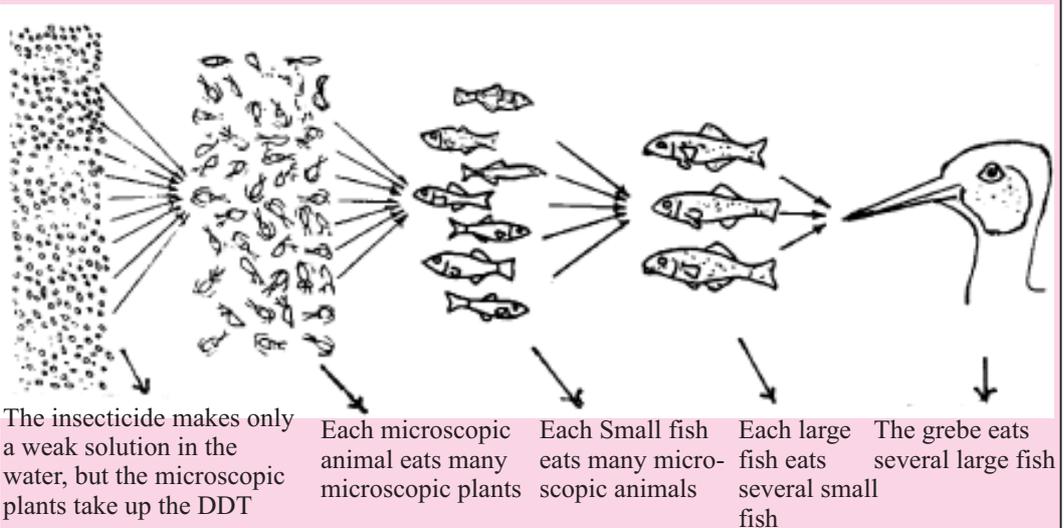


Fig. 27.4 How pesticides affect food chain

Table 27.3 and 27.4 show respectively the industrial sources of water pollution and sources and effects of some water pollutants.

Table 27.3 Sources of industrial pollution

Type of Industry	Inorganic pollutants	Organic pollutant
Mining	Chlorides, various metals, ferrous sulphate, sulphuric acid, hydrogen sulphide, ferric hydroxide surface wash offs, suspended solid, chlorides and heavy metals	
Iron and Steel	Suspended solids, iron cyanides, thiocyanate, sulphides, oxides of copper, chromium., cadmium and mercury.	Oil, phenol and naphtha.
Chemical Plants	Various acids and alkalies, chlorides, sulphates, nitrates of metals, phosphorus, fluorine, silica and suspended particles	Aromatic compounds
Pharmaceuticals		Protein, carbohydrates, organic solvents intermediate products, drugs and antibiotics.

Soap and Detergents	Tertiary ammonium compound alkalies.	Fats and fatty acids, glycerol, phosphates, polysulphonated hydrocarbons.
Food processing		Highly putrescible (easily rots) organic matter and pathogens.
Paper and Pulp	Sulphides and bleaching liquors	Cellulose fibre, bark, wood sugars organic acids,

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Table 27.4 Some water pollutants, their sources and effect on human health

Pollutant	Source	Diseases in humans
Lead	Industrial waste	Nervous disorders, Kidney failure. blood poisoning
Tin	Industrial dust	Affects central nervous system (CNS) Affects, vision
Mercury	Industrial discharge	Affects central nervous system and peripheral nervous system, kidney failure, Numbness of lips, muscles and limbs, Blurred vision
Arsenic	Industrial discharge	Respiratory and skin cancer. Nervous disorder
Nickel	Aerosols, industrial dust	Pulmonary disorders, dermatitis
Cadmium	Industrial discharge	Kidney disorders, Pulmonary and skeletal diseases
Uranium, thorium cesium	Radioactive waste	Leucoderma, skin cancer

27.2.2c Prevention and control of water pollution

Water pollution can be controlled by

- **Treating industrial effluents** before discharging into rivers, separate channels for river and sewage water
- **Avoid contamination of rivers, lakes and ponds** by washing clothes, bathing. etc.
- **Not throwing waste, food materials, paper, biodegradable vegetables and plastic into open drains.**
- Setting up **sewage water treatment plants**
- Use of **septic tanks in houses** to avoid direct outlet of faecal matter and other wastes
- Effluents from distilleries and solid waste containing organic matter diverted to **biogas plants to generate energy**



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- **Maintenance or safety standards** for the effluents discharged into the water system

27.2.2d Treatment of sewage

The sewage can be treated by a modern technique involving three steps— primary treatment, secondary treatment and tertiary treatment.

In **primary treatment** sewage is passed through a grinding mechanism. This is then passed through several settling chambers and lime is added to neutralise it. The neutralised sewage still contains a large number of pathogenic and non-pathogenic organisms and sufficient amount of organic matter.

In the **secondary treatment**, these neutralised effluents are passed through a reactor called UASB (Upflow anaerobic sludge blanket). In this reactor, the anaerobic bacteria degrades the biodegradable material into neutralised effluents. In this process, the foul odour and methane are released and the sewage is converted into clean water. This water is sent to aeration tanks where air and bacteria are added to it. This process is called biological or secondary treatment.

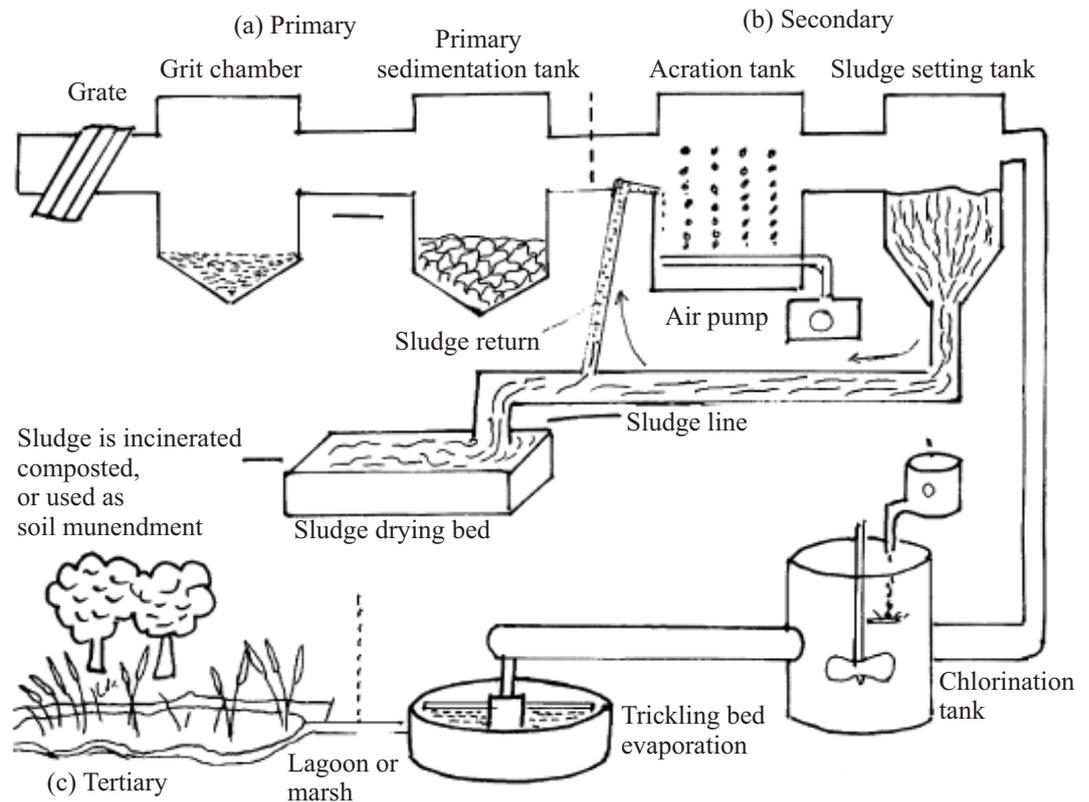


Fig. 27.5 Treatment of sewage

The water obtained as a result of secondary treatment is still unfit for drinking and needs further purification. This is done by **tertiary treatment**. In this treatment, which is a disinfecting process, final traces of disinfecting bacteria and any dissolved

organic solids are removed. Then, the chlorination, evaporation and exchange absorption methods are employed to obtain clean water.



INTEXT QUESTIONS 27.2

- Give two examples of natural sources of water pollution.
 -
 -
- What is biomagnification?
.....
- Give the technical term for enrichment of water bodies with nutrients coming from fields.
.....
- Give one source of and one disease caused by from the following pollutants
 - lead
 - Tin
 - Nickel

27.2.3 Soil Pollution

Addition of substances that change the quality of soil by making it less fertile and unable to support life is called **soil pollution**.

27.2.3a Sources of soil pollution

Soil pollution is caused due to :

- Domestic sources : plastic bags, kitchen waste, glass bottles, and paper
- Industrial sources : chemical residue, fly ash, metallic waste, and
- Agricultural residues : fertilizers and pesticides.

Harmful effects of soil pollution

- Decrease in irrigated land thereby reduction in agricultural production.
- Decrease in soil productivity.
- Carry over of pollutants into the food chain.
- Damage to landscape

27.2.3b Control of Soil Pollution

- Judicious use of chemical fertilizers and pesticides.
- Proper and appropriate irrigation practices
- Conversion of farm wastes into compost and much use of bio fertilizers and manure in farming.



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- Ensure use of pollution free or treated waste water only for irrigation.
- Recycling of waste material for example plastic, metal and glass are recyclable and incineration of non recyclable, wastes.

27.2.3c Soil Erosion

The process of **detaching and removal of loosened soil particles by water (running water, ground water, rain, sea waves) and wind is known as soil erosion.** Soil may be eroded by water and wind, each contributing towards a significant amount of soil loss every year in our country.

Types of soil erosion

Wind erosion

Erosion of large quantity of fine soil particles and sand from deserts by wind is known as wind erosion. It is spread over the cultivated land and thus, destroys fertility of that land.

Sheet erosion

When water moves over the land surface as a sheet, it takes away the topmost thin layer of soil. This phenomenon occurs uniformly on the slopes of hilly areas, riverbeds and areas affected by floods. This type of erosion is known as **sheet erosion.**

Gully erosion

When water moves down the slope as a channel, it scoops out the soil and forms gullies which gradually multiply and spread over a large area. This type of soil erosion is known as **gully erosion.**

Effects of soil erosion

Soil erosion may have several adverse effects such as,

- The top layer of productive land may be washed away.
- Roads, fences, bridges, trees and houses may get damaged.
- Fine soil may be transported far away.
- Crops and pasture lands may be destroyed either by being washed out or by getting covered with mud.
- Flooded fields may take a long time to recover and fertilizers may also be washed out leading to reduction in agricultural yield.
- Organic matter of the soil, residues or any applied manure, is relatively light-weight and can be readily washed off the field. Crop emergence, growth and yield are directly affected by the loss of natural nutrients and fertilizers in the soil. Seeds and plants can get disturbed or completely removed from the eroded soil.
- Soil erosion changes the composition of soil leaving infertile rock behind. Soil quality, structure, stability and texture may also be affected.

- The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure and even change the texture. Textural changes can in turn affect the water-holding capacity of the soil making it more susceptible to extreme conditions, such as drought.
- Sediment which reaches streams or water-courses due to soil erosion clog drainage and stream channels, deposit silt in reservoirs and reduce quality downstream water.



Notes

Causes of Soil Erosion

(i) Natural Sources

Water Erosion: During rainfall, drops of rain can break down soil aggregates and disperse them. The loosened soil particles are transported with the runoff water. If vegetation is depleted by drought, raindrops are free to hit the soil, causing erosion during rainfall.

Wind Erosion: Wind can move large amounts of soil. Wind erosion is a serious means of soil erosion. Blowing soil not only leaves a degraded area behind but can also bury and kill vegetation where it settles. Winds blow away the fine particles of soil during drought.

(ii) Anthropogenic (Produced by humans)

- Extensive cutting down of forests and trees exposes the ground surface to the direct impact of rain and wind. For example, in the absence of proper vegetation cover there is no interception of rainfall and the falling rain strikes the soil surface directly resulting in the throwing up of loose soil particles in the air which are washed away by rainwater.
- Construction work, mining, digging canals and ditches change the structure of soil. This accelerates soil erosion due to high-speed winds as well as rainwater.
- While making roads, soil is cut and massive digging of earth takes place. This leads to soil erosion by water or wind.
- Excessive use of plough, machines, fertilizers and irrigation may damage the land.
- In many areas, trees and grasses are depleted because of overgrazing by animals. This makes the soil susceptible to erosion.

Prevention of soil erosion

Some methods to control soil erosion are discussed below.

- The roots of the trees hold soil material together. Therefore, we should protect our forests and trees from being cut down. Afforestation means planting trees in place of cut-down forest trees. Planting of trees along river-side, waste lands and mountaneous slopes reduces excessive erosion of soil that takes place in these regions. It is also effective in controlling wind erosion.



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- Grazing by domesticated animals in a planned way reduces soil erosion by protecting vegetation cover specially on the hill slopes which are more prone to soil erosion.
- Protected channels for water movement must be provided to stop soil erosion. If the waterways are properly maintained the speed of water gets reduced and soil erosion decreases. Dam should be constructed on rivers to control flooding and consequently soil erosion. This can also be done by diverting water to dry areas through canals, in a planned way.
- Obstructions known as bunds should be constructed in lands affected by gully erosion.
- Terracing is a method of farming to conserve the thin soil layer on the mountain slopes. This helps in controlling soil erosion and using water resources of these areas more economically and effectively for growing crops on these terraces.
- Ploughing and tilling of land along the contour levels in order to cause furrows to run across the land slopes is known as the contour ploughing. This method is most suited to areas that have a rolling landscape.
- Windbreaks which means planting trees to protect bare soil from the full force of wind also help in preventing soil erosion by wind. Windbreaks reduce the velocity of wind thereby decreasing the amount of soil that it can carry away.



INTEXT QUESTIONS 27.3

1. What is soil erosion?
.....
2. Name the various types of soil erosion.
.....
3. Name any two natural factors responsible for soil erosion.
.....
4. How does terracing prevent soil erosion?
.....

Biodegradable and non-biodegradable waste material

The waste generated from various sources can be categorized into two types:

- (i) **Biodegradable waste** includes substances that can be degraded by microbes into harmless and non-toxic substances. Sewage, kitchen waste, agricultural and animal wastes like leaves, twigs, hay, dung, etc. are biodegradable waste.
- (ii) **Non-biodegradable waste** cannot be easily degraded. Aluminium cans, plastics, glass, DDT, etc, are examples of non-biodegradable wastes. Radioactive wastes produced during nuclear reactions take a long time to decay and are harmful to human beings.

If a waste material is processed by some means and converted to a product, we call the process **recycling**. Recycling helps in efficient management of wastes and also reduces the load on natural resources.

Use of cow dung for the production of biogas is a good example of recycling of waste for the production of energy.



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27.2.4 Noise pollution

Noise can be simply defined as “unwanted sound”. It is generally higher in urban and industrial areas than in rural areas. Workers using heavy machinery are exposed to high noise levels for long period of work hours every day. Intensity of sound is measured in a unit called **decibel** or **dB**. *The lowest intensity of sound that human ear can hear is 20 dB.*

27.2.4a Sources of noise pollution

The major sources of noise pollution are :

- Use of loud speakers, loud music system and television at public places
- Means of transport i.e. automobiles, railways, aircrafts, etc.
- Heavy machines in industries fireworks

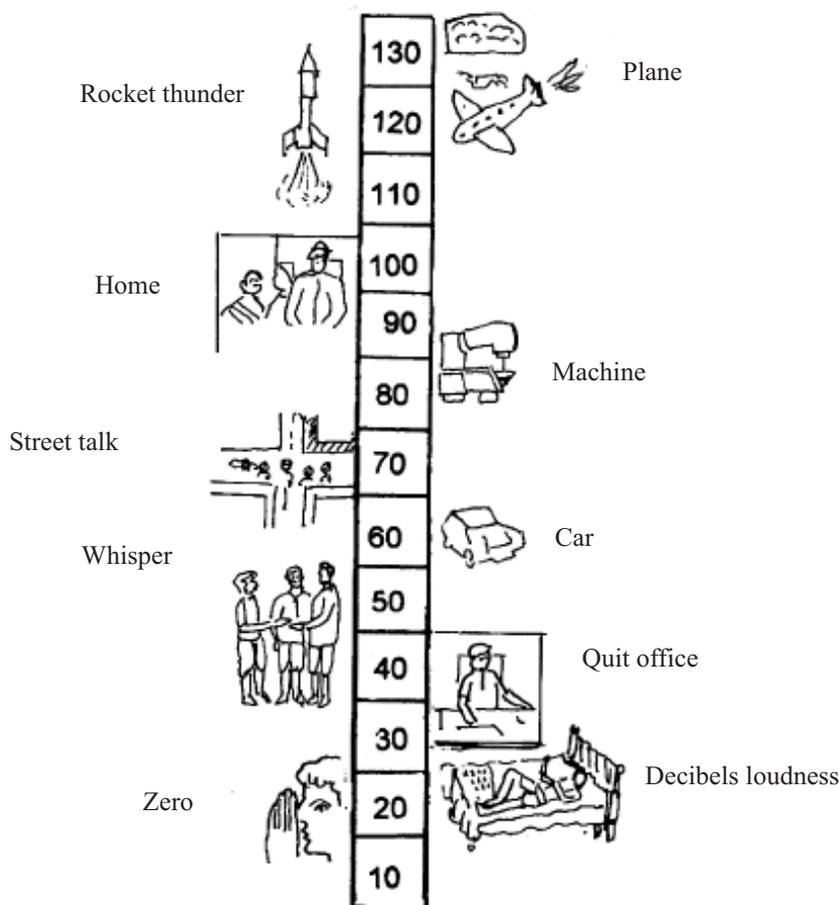


Fig. 27.6 Sources of noise pollution



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27.2.4b Effects of noise pollution

- Inability to sleep, slow recovery from sickness.
- Irritability and interference in communication.
- Temporary loss of hearing, earache, sometimes even leading to permanent deafness.
- Inability to concentrate, headache.
- Ringing of ears (a feeling, sound coming from within the ear in a very quiet environment).
- Increased blood pressure, irregular heart beat.

27.2.4c Prevention and control of noise pollution

Following steps can be taken to control or minimize noise pollution :

- Control the noise emanating from your radio and television.
- Use automobile horn only in case of emergency.
- Do not burn fire crackers as they are noisy and also cause air pollution.
- Get all machinery and engines properly tuned and serviced at regular intervals and by the use of silencers.
- Use of sound proof cabins and sound-absorbing materials in the walls.
- A green belt of vegetation is an efficient absorber of noise.
- Not playing loudspeakers during odd hours. It is legally banned and should be reported to the police immediately.

27.3 GREENHOUSE EFFECT AND GLOBAL WARMING

In the earlier classes, you have studied about greenhouse effect and global warming. Greenhouse is an enclosure usually made of glass in which temperature inside is higher than outside. An increase in the percentage of greenhouse gases which prevent the escape of heat from earth, would increase the average temperature on earth worldwide known as greenhouse effect.

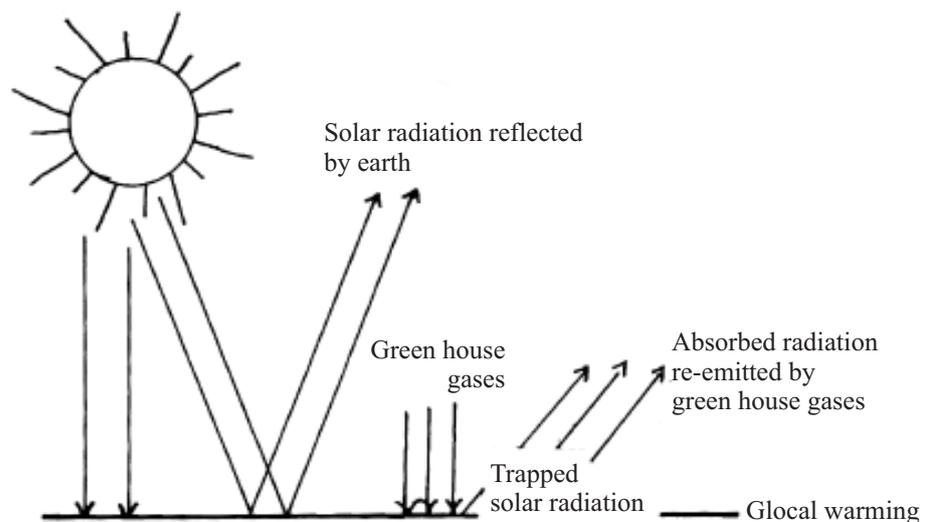


Fig. 27.7 (a) Green house effect

Greenhouse gases in the atmosphere behave much like the glass panes in a greenhouse. They allow sunlight to enter the atmosphere of earth. When the sunlight enters the surface of the earth, sun's energy is absorbed by land, water and biosphere. Some of this energy is reflected back to the atmosphere by earth. Some of this energy passes back into the space. However, most of the energy remains trapped in the atmosphere by the greenhouse gases causing global warming on earth.



Notes

27.3.1a Causes of global warming

Carbon dioxide (CO_2), Chlorofluorocarbons (CFCs), Methane (CH_4) and Nitrous oxides (N_2O) are the main greenhouse gases that cause global warming. An increase in the concentration of these greenhouse gases leads to an increased trapping of long wave radiations resulting in an increase in earth's temperature causing **global warming**.

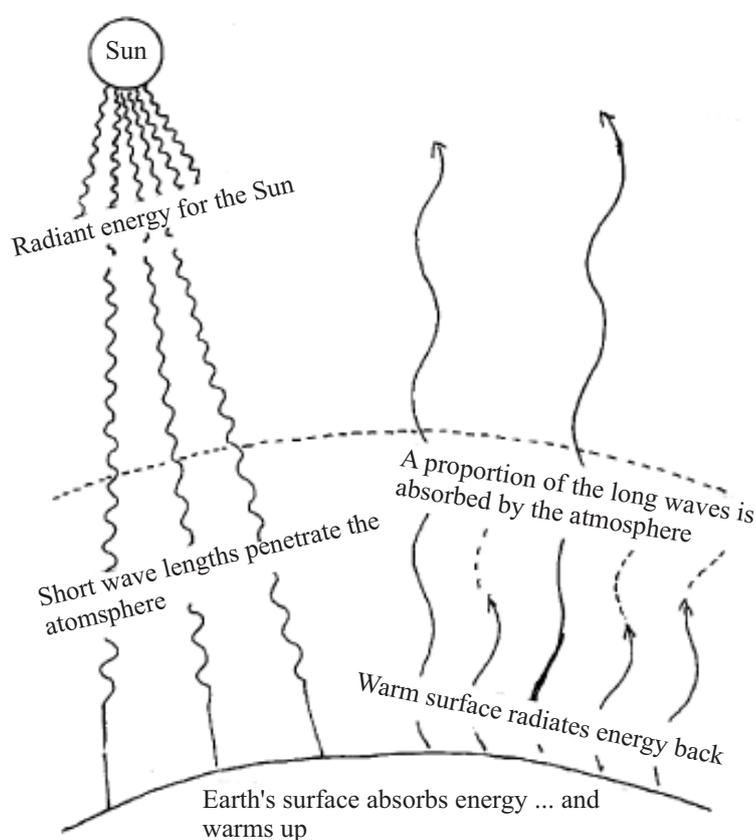


Fig. 27.7 (b) Global warming

There are various sources which add these greenhouse gases to the atmosphere.

- Human activities such as burning of fossil fuels in homes, industries and automobiles, biomass burning in agricultural practices etc. add large amount of carbon dioxide to the atmosphere.
- Marshes, paddy field, cattle sheds and biogas plants add methane to the atmosphere.



Notes

- Refrigerators, air conditioners etc emit CFCs to the atmosphere.
- Nitrogen oxides are added to the atmosphere by organic matter and fertilizers by denitrifying bacteria as well as automobiles.

27.3.1b Effects of global warming

- An increase in the atmospheric temperature will cause sea level to rise by 1 to 2 mm per year.
- Temperature near ocean surface would increase and cause glaciers and polar ice sheets to melt faster. This would flood the low lying coastal areas and a number of islands.
- Global warming will produce severe heat waves during summers causing heat related illness and death.
- Due to increase in surface temperature, the parasites and pests will get adequate temperature to survive leading to an increase in their numbers. This will reduce the crop production and there will be more incidences of plant, animal and human diseases.
- Due to increased temperature of earth's atmosphere, the precipitation of water will increase. This will decrease the soil moisture content and lead to frequent downpours also.

27.3.1c Prevention and control of global warming

We can prevent global warming by reducing the production of greenhouse gases. This can be done by

- using energy efficient devices in automobiles and appliances other than fossil fuels.
- minimizing the use of fossil fuels such as petrol, diesel etc and opt for better alternatives like solar energy and other renewable sources of energy.
- reusing home wastes, newspapers, cardboards, glass and metals. By doing so we can reduce the CO₂ emission by 850 pounds annually.
- planting more and more trees. By planting more and more trees we can reduce the amount of CO₂ in the atmosphere. Because plants act as CO₂ sink as they take up CO₂ for photosynthesis.

27.3.2 The ozone hole : depletion of the ozone layer

The ozone layer present in the earth's atmosphere prevents the entry of sun's harmful ultraviolet (UV) radiations reaching the Earth's surface. Industrial use of chemicals called chlorofluorocarbons (CFCs) in refrigeration, air conditioning, cleaning solvents, fire extinguishers and aerosols (spray cans of perfumes, insecticides, medicines, etc.) damage the ozone layer. The ozone hole is formed as follows :

Chlorine contained in the CFCs on reaching the ozone (O₂) layer splits the ozone molecule to form oxygen (O₂) Amount of ozone, thus, gets reduced and cannot prevent the entry of UV radiations. There has been a reduction by 30-40% in the thickness of the ozone umbrella or shield over the Arctic and Antarctic regions.

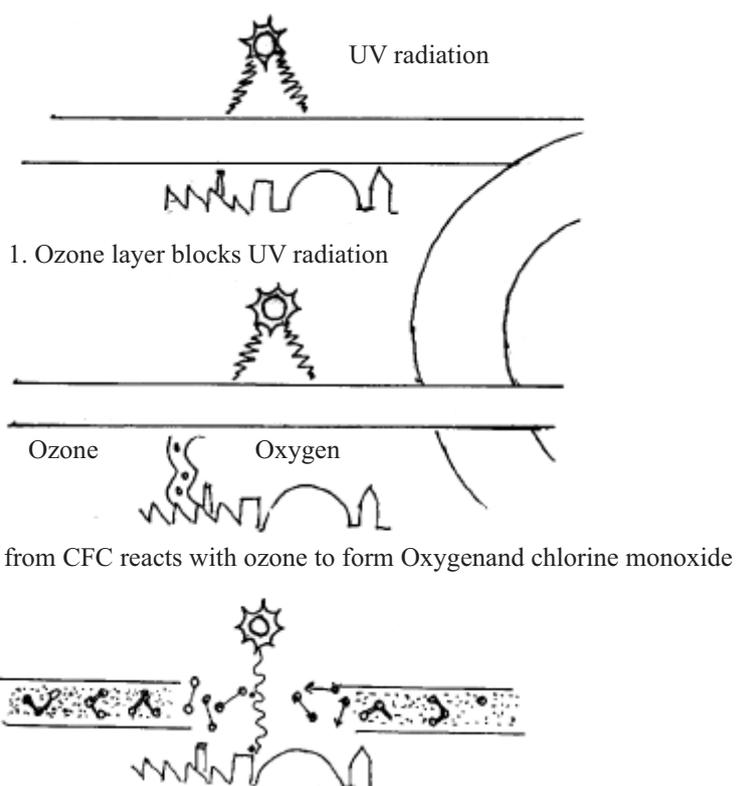


Fig. 27.8 Depletion of the ozone

27.3.2a Effects of depletion of ozone layer

- Sunburn, fast ageing of skin, cancer of skin, cataract (opaqueness of eye lens leading to loss of vision), cancer of the retina (sensitive layer of the eye on which image is formed)
- Genetic disorders
- Reduced productivity in the sea and the forests

27.3.2b Prevention of ozone layer depletion

Damage to the ozone layer can be prevented by :

- Reduced consumption of CFCs by adopting alternative technologies (substituting air conditioning gases by non-CFCs).
- Discouraging the use of spray cans containing aerosol.

27.3.3 Acid rain

Acid rain occurs when Sulphur dioxide (SO_2) and oxides of Nitrogen (NO_x) are emitted into the atmosphere, undergo chemical transformations and are absorbed by water droplets in clouds. This causes the formation of sulphuric and nitric acids in rain clouds. The droplets then fall to earth as rain, snow or mist. If rain falls through polluted air it picks up more of these gases and increases its acidity. This is called **acid rain**. This can increase the acidity of the soil, and affect the chemical



Notes



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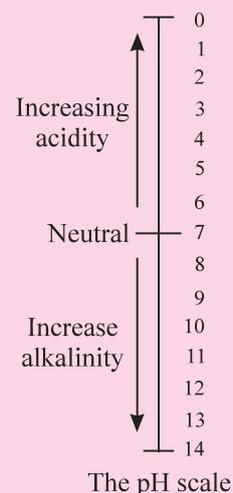
balance of lakes and streams. Thus, acid rain is defined as any type of precipitation with a pH that is unusually low. A pH of less than about 5 is used as a definition of acid rain. Acid rain is a serious environmental problem that affects large parts of the world.

What is pH?

Acid rain is measured using a scale called pH. Because acids release hydrogen ions, the acid content of a solution is based on the concentration of hydrogen ions and is expressed as “pH.” This scale is used to measure the acidity of rain samples.

- 0 = maximum acidity
- 7 = neutral point in the middle of the scale
- 14 = maximum alkalinity (the opposite of acidity)

The **smaller** the number on the pH scale, the more **acidic** the substance is. Rain measuring between 0 and 5 on the pH scale is acidic and therefore called acid rain. Clean rain usually has a pH of 5.6. It is slightly acidic because of carbon dioxide which is naturally present in the atmosphere. On the other hand, vinegar is very acidic and has a pH of 3.



27.3.3a Sources of acid rain

Sulphur dioxide (SO₂) is generally a byproduct of industrial processes and burning of fossil fuels. Ore smelting, coal-fired power generators and natural gas processing are the main contributors to sulphur dioxide in the atmosphere.

The main source of oxides of nitrogen (NO_x) emissions is the combustion of fuels in motor vehicles, residential and commercial furnaces, industrial and electrical-utility boilers and engines, and other equipments.

27.3.3b Effects of acid rain

It causes acidification of lakes and streams and contributes to the damage of trees and many sensitive forest soils. In addition, acid rain accelerates the decay of building materials and paints, including heritage buildings, statues, and sculptures that are part of our nation’s cultural heritage. Prior to falling to the earth, sulphur dioxide (SO₂) and nitrogen oxide (NO_x) gases and their particulate matter derivatives— sulphates and nitrates— contribute to visibility degradation and harm public health.

Some major effects of acid rain on vegetation, buildings and human health are given here.

Effect on surface waters and aquatic animals

Lower pH in surface water that occurs as a result of acid rain can cause damage to fish and other aquatic animals. Acidity releases aluminium into the water. This

builds up as a layer of aluminium hydroxide in the gills of fishes. At pH lower than 5 most fish eggs do not hatch and lower pH can kill adult fish. As lakes become more acidic biodiversity is reduced.

Damage to plants

Acid rain is highly injurious to plants. Acid Rain depletes minerals from the soil and then it stunts the growth of the plant. It causes death of young shoots, leaves turn yellow and fall off. The fine root structure is damaged and the whole plant eventually dies. Acid rain can slow the growth of forests, cause leaves and needles to turn brown and fall off and die. In extreme cases trees or whole areas of the forest can die.

Effect on human health

The human beings may also be affected due to acid rain. Fine particles, formed from the same gases dissolve in water and form as acid rain (sulphur dioxide and nitrogen dioxide) may cause illness in humans.

Damage to soil

Acid rain may make the soil more acidic. It may cause mineral nutrients to be washed away. It can release toxic chemicals such as aluminium and mercury into the soil. Thus, acid rain could make soil less fertile. The microbes which are unable to tolerate low pHs may be killed due to acid rain. This is because the enzymes of these microbes may be denatured by the acid.

Other adverse effects

Acid rain can also cause damage to certain building materials and historical monuments. Acid rain can cause erosion of ancient monuments. This is because the Sulphuric acid in the rain chemically reacts with the calcium in the stones (limestone, sandstone, marble and granite) to create gypsum. Which then flakes off. Acid rain also causes an increased rate of oxidation for iron affecting iron furnitures, grills, doors, windows and other materials etc. Acid rain can also reduce visibility due to presence of sulphate and nitrate in the atmosphere due to acid rain.

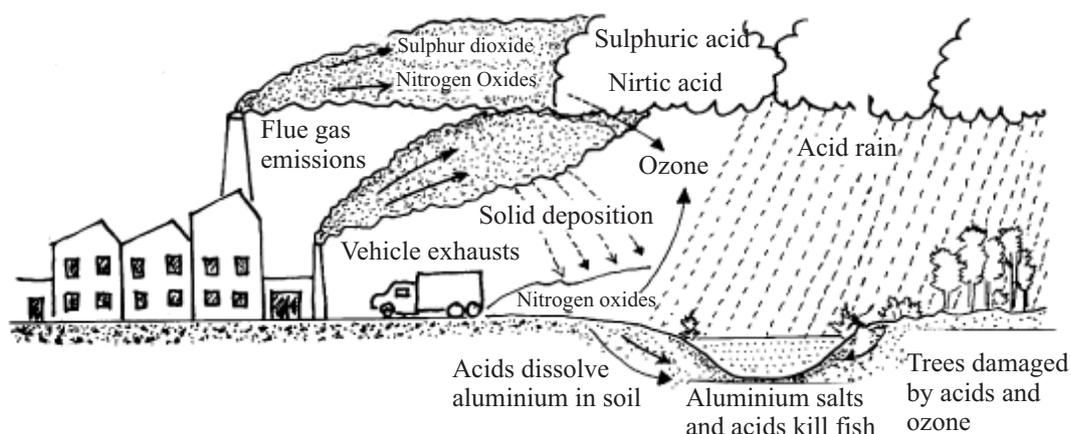
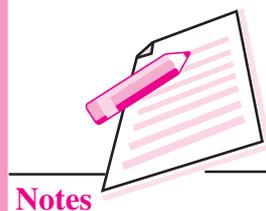


Fig. 27.9 Sources and effects of acid rain.





Notes

27.3.3c Prevention of acid rain

- There are several ways by which sulphur dioxide and nitrogen oxide emissions can be reduced.
- Coal can be crushed and washed before burning.
- Oil can be treated to remove sulphur.
- Cleaning systems can be fitted into chimneys to remove sulphur dioxide before it can be released into the atmosphere.
- Improved furnaces can be built which burn fuel more effectively and produce less pollution.
- Vehicle exhausts can be fitted in vehicles, which remove pollutants from engine emissions.



INTEXT QUESTIONS 27.4

1. Name any two biodegradable pollutants.
.....
2. Mention two source of noise pollution.
.....
3. Name any two green house gases.
.....
4. What is acid rain?
.....

27.3.4 Radiation—an environmental pollutant

Radiation is one of the chief forms of energy consisting of high energy particles. Radiation could be natural (solar and cosmic) or and human (nuclear). Radiation has also become a major factor causing environmental pollution.

Radiation may have both short term or long term effects. They can further be divided functionally into :

- Ionising and
- Non Ionising (Table 27.5) radiations

Table 27.5: Ionizing and Non Ionizing Radiations

Type	Ionizing	Non ionizing
Examples	Alpha, Beta, Gamma and X-Ray	Ultraviolet radiation
Properties	Short wave lengths, high energy.	Higher wave lengths, low energy
Effects	Causes ionisation in cells photo products	Damage through toxic
Harmful Effects	<ul style="list-style-type: none"> ● Deep penetrating power effects both external & internal organs 	<ul style="list-style-type: none"> ● Only superficial tissues are damaged



Notes

as lead absorbs all radiation. These containers are then dumped in deep pits or in high seas.

Protection against radiation

Exposure to radiation may affect both young and adults. Entry of children and pregnant females is prohibited in the nuclear installations. Nuclear radiation may have the following harmful effects

- Cancer in child
- Male sterility
- Malformation of the growing embryo

People working in the nuclear establishments can be provided protection against radiation by

- Increasing the distance between the source of radiation and the working people.
- Use of lead shields to serve as absorbing material.
- Thick concrete walls around the reactor to work as shields
- Use of protective apron and gloves for people.

Applications of Radiation

Despite all the harmful effects of radiation, their use in various fields for the benefit of mankind is gradually increasing as show in Table 27.6. Almost all our sources of energy originate from **solar radiation**. For example **photosynthetic process** for the formation of food and fossil fuel. Artificially generated radiation are also used for various purposes.

Table 27.6: Applications of Radiation

Field	Use
1. Industry process	Radiation detector for metals, moisture, quality,
2. Nuclear Energy	Power Plants
3. Communications	Radio, TV, Satellite,
4. Medicine	Radiation Tomography (CAT Scan), X ray for anatomy Diathermy to relieve pain by localised heating Artheritis Destruction of cancerous growth Sterilisation of surgical instruments
5. Scientific research	Radiocarbon dating - to determine the age of objects or fossils



INTEXT QUESTIONS 27.5

1. Give one example each of natural and man made radiations
 - (i)
 - (ii)
2. List two wastes of atomic explosion.
 - (i)
 - (ii)
3. Name the containers which should be used for the disposal of nuclear wastes.
.....
4. List any two harmful effects of nuclear radiations.
 - (i)
 - (ii)



WHAT YOU HAVE LEARNT

- Pollution is the addition of undesirable material in the environment.
- A pollutant is a constituent which when added adversely affects the environment.
- Pollution may be of different types such as Air, Water, Soil, Noise, Thermal or because of radiations.
- Pollutant could be gaseous, particulate or a physical factor.
- Air Pollution turns clear, odourless, air into hazy and/or smelly.
- Air pollution causes a number; of respiratory problems such as anaemia, heart palpitation, choking and eye irritation.
- Plants may show chlorosis, necrosis, stunted growth, leaf and fruit fall due to air pollution.
- Air pollution caused by suspended particular matters may be controlled by use of filter bags, electrostatic precipitators and by planting vegetation.
- Water may be polluted by domestic, agricultural or industrial activities.
- Biodegradable matter present in water causes depletion of oxygen content and death of aquatic life.
- Uncontrolled release of pollutants by the industry has made water in water streams unfit for human consumption.
- Use of non biodegradable pesticides (DDT etc.) gives rise to the phenomenon of biomagnification.



Notes

**Notes**

- Soil pollution may be caused due to pesticides, radioactive wastes, domestic wastes etc.
- Noise is unwanted sound which may cause deafness, lack of concentration, high blood pressure and nervous disorders.
- Soil pollution includes addition of substances that reduce the fertility of the soil.
- Waste can be classified into biodegradable (e.g. cow dung, vegetable peels, paper, wood etc.) and non-biodegradable (e.g. aluminium cans, glass bottles, plastics, DDT etc.).
- Recycling of wastes such as cow dung, paper, sewage and rice husk, into useful products help in conservation of resources.
- Ozone provides a protective layer against harmful ultra-violet rays coming from the sun. Excessive use of chemical, such as CFCs used in spray cans, gas used in refrigerators and air conditioners, lead to thinning of the ozone layer.
- Accumulation of high concentration of carbon dioxide has led to the phenomenon of global warming (due to green house effect), and has resulted in increased earth's temperature. The climate has changed.

**TERMINAL EXERCISES**

1. Which of the following are biodegradable materials?
Aluminium, wood, fruit peels, DDT, paper, glass, dung
2. Which gaseous pollutant has the ability to absorb infra-red radiations?
3. A ship carrying oil from the gulf region collides with huge rocks and gets damaged. Is this just news or has some serious consequences? Give your opinion in one sentence.
4. To set up a new industry, a large forest area had to be cut. List four ways in which the environment in that area may be affected.
5. List any three ways in which noise from various sources can affect the well-being of a person. Suggest few methods to control noise pollution.
6. What does 'Global warming' mean? Name the gas responsible for this phenomenon and why should it be considered an environmental problem.
7. How would you classify the waste generated at home? What is the difference between the different groups? How would you manage this waste so that it causes least pollution?



ANSWERS TO INTEXT QUESTIONS

- 27.1**
1. Addition of unwanted substances to the environment which have adverse effects on organisms.
 2. Air pollution, water pollution, land pollution, noise pollution.
 3. Respiratory problems in humans, chlorosis (loss of chlorophyll in plants).
- 27.2**
1. Soil erosion/leaking of mineral from rock/decay of organic matter (any two)
 2. Accumulation in greater concentration of chemicals at higher levels of food chain.
 3. eutrophication
 4. See table 27.3
- 27.3**
1. Detachment and removal of soil particle by flowing water and blowing wind.
 2. Wind erosion, sheet erosion, Gully erosion.
 3. Wind, water
- 27.4**
1. Sewage, kitchen, waste, certain agricultural waste, hay, dung etc. (any two)
 2. loud speakers/sound of automobiles/sound from heavy machines/fire works (any two)
 3. Nitrogen oxides, methane, carbon dioxide, chlorofluoro carbons. (any two)
 4. When harmful gases like SO_2 and NO_x in the atmosphere dissolve in water to form acid during rains.
- 27.5**
1. Solar/cosmic (any one); x-ray/gamma rays (any one)
 2. Radioactive Iodine and strontium
 3. Lead containers
 4. (i) cancer (ii) gene mutations.



Notes