Ratna Sagar

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Education, Our Mission

As per the latest ICSE syllabus 2022

Ratna Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

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10

EDUCATION, OUR MISSION

ICSE
Living Science
Biology

Class 10

Chapter 16 Pollution

LEARNING OBJECTIVES

Pollution and pollutants

Air pollution

- Sources of air pollution
- Effects of air pollution
- Methods of controlling air pollutants

Water Pollution

- Sources of water pollution
- Effects of water pollution
- Prevention and control of water pollution

Soil Pollution

- Causes of soil pollution
- Prevention and control of soil pollution

Classification of waste materials

- Biodegradable wastes
- Non- biodegradable wastes

Noise Pollution

- Sources of noise pollution
- Harmful effects of noise pollution
- How to control noise pollution

Pollution due to radiation

What is environment and what are its major components?

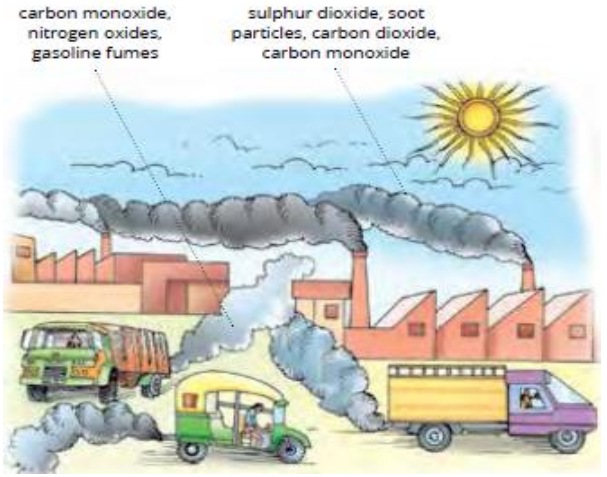
Environment can be defined as the physical and biological world where we live.

Environment has three major components:

1. Physical surroundings
2. Living organisms
3. Climatic factors or meteorological components

Pollution and pollutants

Pollution may be defined as an undesirable change in the physical, chemical and biological characteristics of our surroundings which adversely affect the natural quality of the environment, human life and other living beings. The substances that cause pollution are called **pollutants**.



Air pollution

Air pollution may be defined as the occurrence or addition of foreign particles, gases and other materials into the air, which adversely affect the biological communities (human beings, plants, and animals) and physical surroundings (roads, buildings).

Sources of air pollution

There are two sources of air pollution – natural and man-made.

Natural sources

- Forest fires, ash from smoking volcanoes, dust from storm, decay of organic matter
- Pollen grains floating in air

Man-made sources

- Transportation: Motor transport and internal combustion engines that burn petrol, diesel, kerosene, etc.,

which causes release of carbon monoxide, hydrocarbons and nitrogen oxides.

- ❖ Fuel combustion: Industrial plants and power stations using coal or crude oil
- ❖ Burning of vegetable oils, kerosene and coal in households
- ❖ Furnaces using coal, cow dung cakes, firewood, kerosene, etc.
- ❖ Burning of garbage and dust from brick kilns

Air pollutants

The air pollutants may be grouped under two categories.

1. Particulate air pollutants: The particulate air pollutants include solid particles suspended in air, smoke, soot, aerosols, dust and mists. They also include dust of cement, brick kilns, glass, ceramics and aerosols. Particles given off in the manufacture of metal items, cotton dust from textile industries and even pollen grains are also particulate air pollutants.

2. Gaseous air pollutants: These include smoke given out from cigarettes, *biri*, cigar and other tobacco products and burning of coal, firewood, cow dung cakes, kerosene oil, etc.

Carbon dioxide

It is chiefly produced during the combustion of fuels in households, factories, power stations, etc. The increasing content of CO_2 in the atmosphere is likely to have the following effects.

❖ A rise in atmospheric temperature due to **greenhouse effect**

❖ More CO2 will dissolve in water and the water in the oceans would be more acidic.

❖ The rise in temperature due to more CO_2 would cause melting of continental and mountain glaciers leading to flooding of coastal areas of some countries.

Major sources of air pollution

Greenhouse effect

❖ In greenhouse effect, the greenhouse gases such as CO2 and methane, produced by burning of fossil fuel, agriculture and deforestation trap heat radiated from earth and lead to increase in earth's temperature.

❖ Rays of sunlight penetrate the lower atmosphere and warm the earth's surface.

❖ The earth's surface radiates heat (infrared wavelengths) to the lower atmosphere. But greenhouse gases and water vapour absorb these infrared wavelengths and reradiate a portion back towards the earth.

❖ As the concentration of greenhouse gases increases in the atmosphere, the surface temperature of the oceans rises, more water evaporates into the atmosphere, and the earth's surface temperature also rises.

Carbon monoxide

It 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**. **Carbon monoxide is more dangerous than carbon dioxide**. It is a poisonous gas leading to respiratory problems.

Sulphur dioxide

It is **produced by the burning of coal in powerhouses and automobiles**. It is mainly absorbed by water and goes into the soil as sulphuric acid. **It causes chlorosis and necrosis of vegetation,** irritation in eyes, asthma and bronchitis.

Acid rain: Emissions of sulphur dioxide and oxides of nitrogen from power stations, factories and motor vehicles cause the formation of sulphuric and nitric acids in rain clouds. If rain falls through polluted air, it picks up more of these gases and increases its acidity. This is called **acid rain**.

Smog

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

Hydrocarbons

Hydrocarbons are produced due to incomplete combustion of burnt fuel. The most prominent hydrocarbon in air is **methane (CH_4)**. Hydrocarbons are a cause of smog and cause skin cancer, irritation in eyes and respiratory system.

Aerosol spray propellants

The suspended fine particles in the air are known as aerosols. It is a group of chemicals, which are released into the air with force in the form of vapours or fine mist. Aerosols contain chlorofluorocarbons (CFCs) and fluorocarbons which cause depletion of the ozone layer.

Oxides of nitrogen

A few oxides of nitrogen, such as nitric oxide (NO), nitrous oxide (N2O) and nitrogen dioxide (NO_2) are important air pollutants. Oxides of nitrogen are produced by natural processes as well as from thermal power stations, factories, automobiles and aircrafts. They reduce the oxygen carrying capacity of blood, may cause irritation in eyes and skin cancer in human beings.

Pesticides

Extensive use of pesticides pollute the environment as they are not biodegradable. For example, DDT that gradually accumulates in the cells and tissues of plants is harmful to animals as well as human beings.

Peroxyacetyl nitrate (PAN)

PAN is formed due to the photochemical reaction **of nitrogen oxides and hydrocarbons**. In human beings, it causes stinging of eyes, cough, headache, pulmonary congestion, haemorrhage, dry throat, breathing problems and early ageing of the lung tissues.

Effects of air pollution on human health

❖ Carbon monoxide combines with the haemoglobin molecules in human blood and causes suffocation.

❖ Depletion of ozone layer due to CFCs causes skin cancer as a result of over exposure of the human skin to UV rays.

❖ Sulphur dioxide originated smog blocks the human respiratory system leading to the death of the sufferer.

❖ Sulphur dioxide pollution also causes diseases of the eyes, throat, nose and lung infections.

❖ Sulphur dioxide pollution also causes acid rain, which pollutes the water and thus, affects the health of persons consuming such polluted water.

❖ Nitric oxide (NO) in high concentration causes respiratory problems, gum inflammation, internal bleeding, oxygen deficiency, pneumonia and lung cancer.

❖ Air pollutants like **suspended particulate matter** (SPM) cause asthma, lung cancer and asbestosis.

❖ Some pesticides like DDT (Dichloro-diphenyltrichloro ethane) are very toxic. When these pesticides enter our food chain and accumulate in our body (a process known as biomagnification), cause kidney disorders and brain and circulatory system related disorders.

❖ Sudden leakage of poisonous gases from factories and chemical plants kill hundreds of people and livestock.

Methods of controlling air pollutants

❖ **Combustion:** This technique is used for controlling those air pollutants that are in the form of organic gases or vapours. In this technique, organic pollutants are converted into less harmful products such as CO_2 and water vapour.

❖ **Absorption:** In this technique, gaseous pollutants are passed through absorbing material like scrubbers.These scrubbers contain a liquid absorbent. This absorbent modifies or removes one or more of the pollutants present in gaseous effluents. Thus, the air coming into scrubber is free from pollutants and it is discharged into atmosphere.

❖ **Adsorption:** In this technique, gaseous effluents are passed through porous solid absorbent kept in suitable containers.

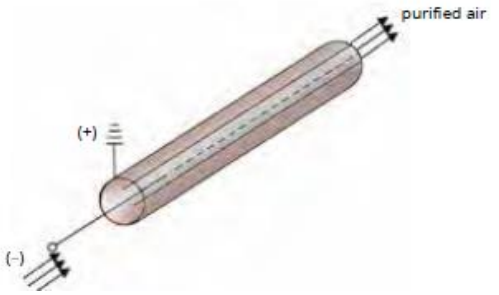
The gaseous pollutants either stick or get absorbed at the surface of the porous material and clean air passes through. The organic and inorganic constituents of gaseous effluents.

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. These are given below.

- **Mechanical devices:** The mechanical devices work either by gravity in which the particle settle down by gravitational force; or by sudden change in the direction of gas flow in which particles separate out due to greater momentum.
- **Fabric filters:** In this technique, gaseous emission containing dust, soot and fly ash is passed through porous fabric filters made of fabric. The particles of pollutants present in the gas get trapped in this fabric and are collected in the filter and the gases free from the pollutant particles are discharged.
- **Wet scrubbers:** The wet scrubbers are used in chemical, metallurgical and mining industries. The wet scrubbers trap SO_2, NH_3 and metal fumes in their tank and clean gases are discharged in the atmosphere.

❖ **Electrostatic precipitators:** An electrostatic precipitator is a device containing a chamber that induces an electric charge on the particles of polluted air. These particles are then attracted to the oppositely charged electrode and are deposited there.



In this technique, a gas or air steam 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 electrode.

Water Pollution

Water pollution may be defined as a change in physical, chemical and biological properties of water by the addition of undesirable substances which may have harmful effects on human and aquatic life.

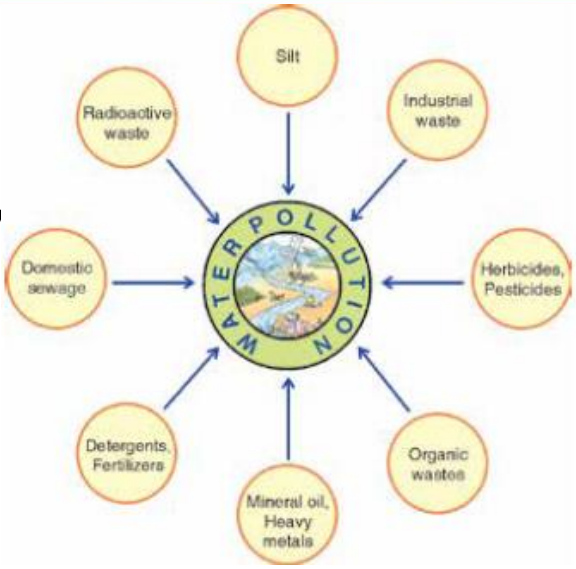
Sources of water pollution

Water pollution occurs due to its two sources –

1. Point sources: These sources discharge water pollutants directly into the water. For example, factories, power plants, underground coal mines,

oil wells situated near water bodies, etc., are point sources of water pollution.

2. Non-point sources: These sources do not have any specific location for discharging pollutants in the water body. For example, run offs from field, lawns, gardens, construction sites, water-logging areas, roads and streets are some non-point sources of water pollution.



Pollution of freshwater

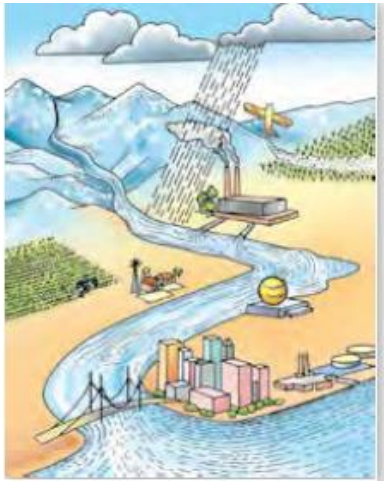
Freshwater is naturally occurring water on earth's surface in ponds, rivers, lakes and streams, and groundwater in underground streams. Freshwater has salt concentration of less than 1% and hence is not saline. Freshwater may be polluted in many ways:

❖ **Domestic sewage** discharged into rivers without treating it. Phosphate and nitrate ions from **excretory wastes of humans and animals** pollutes the water. This may cause diseases like typhoid, cholera, dysentery, etc., in the persons drinking such water.

❖ **Organic wastes** from agricultural fields with phosphate and nitrogen fertilizers that reach lakes, rivers and sea (water becomes deoxygenated and poisonous, thus, cannot support aquatic life).

❖ **Industrial wastes** (effluents) from urban areas containing high concentration of oil, heavy metals, synthetic detergents and alkalis.

❖ **Pesticides, insecticides** such as DDT and some industrial waste containing mercury pollute the water and reach the food chain and ultimately in humans, affecting aquatic and human health.



Effects of water pollution

❖ The presence of **acids and alkalis in water destroys microorganisms,** thereby hindering the self-purification process in rivers.

❖ Water pollution **adversely affects aquatic life.**

❖ The **toxic materials may enter the food chain** and cause serious health hazards in human beings and other aquatic animals.

❖ Polluted water **cause 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** and decreases the agricultural production.

❖ Heavily polluted water **affects the soil, decreases its fertility and kills soil microorganisms** and even certain useful bacteria.

❖ The use of water contaminated with salts **increases alkalinity of the soil**.
❖ Contamination of seawater due to oil slicks caused by the leakage of crude oil from oil tankers results in the death of sea organisms including fishes.

Prevention and control of water pollution

Some steps to reduce water pollution are listed below.

❖ **Setting up sewage water treatment plants** before its disposal into rivers.
❖ **Use of septic tanks in houses** to avoid direct outlet of faecal matter and other wastes.
❖ **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.**
❖ Effluents from distilleries and solid waste containing organic matter diverted to **biogas plants to generate energy.**
❖ **Treating industrial effluents** before discharging into rivers
❖ **Total ban on nuclear waste dumping in water.**
❖ **Generating public awareness** about the maintenance of ponds, river, lakes and wells in rural and urban areas.
❖ **Biomedical waste** like needles, syringes, soiled dressings, etc. to be disposed properly.

Soil Pollution

Any substance that reduces the productivity of soil is known as soil pollutant and the process, as soil pollution.

Causes of soil pollution

Soil pollution (also known as land pollution) is mainly caused by the following:

- **Solid waste** (farm and animal manure)
- **Agricultural waste** like plant remains, fertilizers, pesticides and other chemicals.
- **Dead animal carcasses**
- **Industrial waste** chemicals like fly ash and residues of combustion of solid fuels.
- **Domestic garbage**, paper pulp, plastic, rubber, cloth, leather, metal scrap and glass.
- Biomedical waste such as used syringes, cotton pads, needles, dirty dressings and discarded biological research materials. When disposed off in the garbage pollutes soil and affects soil organisms.

Prevention and control of soil pollution

- Effluents from industries and factories should not be allowed to enter the soil indiscriminately.

❖ **Drainage system should be so developed that the polluted water does not get mixed up with the soil.**

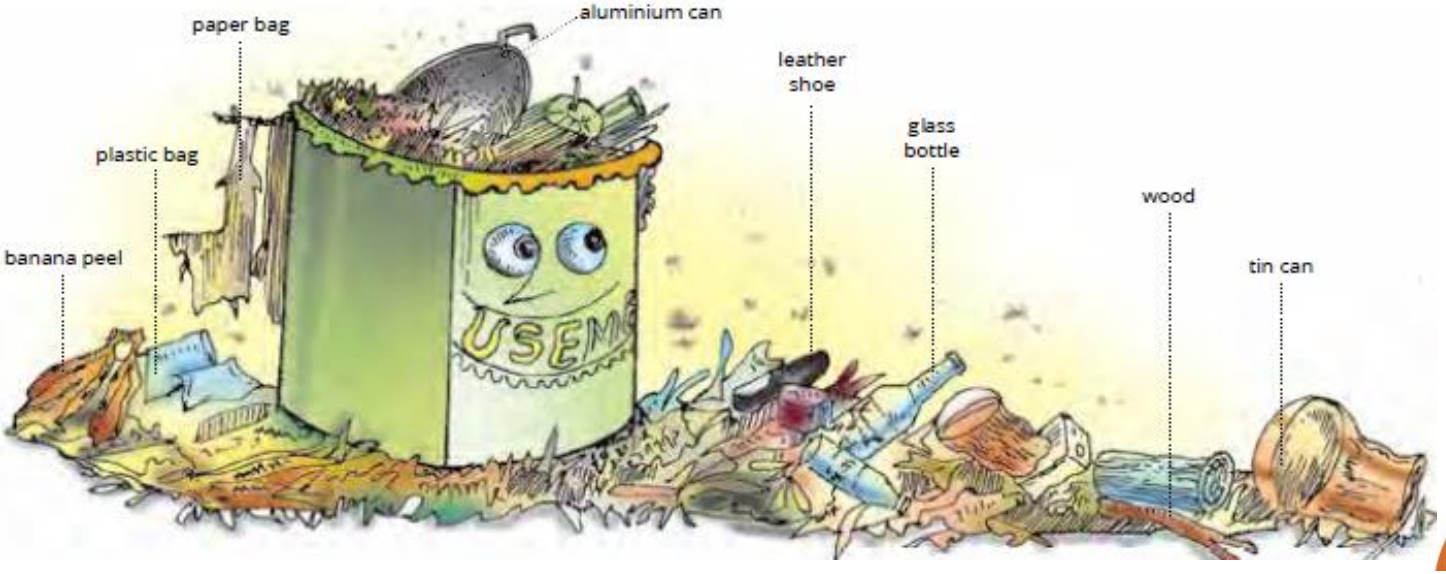
❖ **Proper toilet facilities** should be provided to all and awareness should be created about the harmful effects of defecation in open places.

❖ Fertilizers, pesticides and insecticides should be used judiciously so that **excess chemicals are not washed into the soil**.

❖ **Safe methods of disposal** of domestic, agricultural and industrial solid wastes should be adopted.

Classification of waste materials

The waste materials can be broadly classified into two types – biodegradable waste materials and non-biodegradable waste materials



Biodegradable waste materials

The waste materials that can be broken down or decomposed into simple substances in nature, by the action of microorganisms, such as bacteria, in due course of time are called **biodegradable waste materials.** The biodegradable waste decomposes naturally and becomes harmless to humans, other organisms and environment after some time. For example, dead plants and animals (including bones), animal excreta (cattle dung, urine), leather goods, tea leaves, wool, paper, plant parts, hay and wood, cotton clothes, cardboard, seeds, grains and compost (manure made from decayed plants and vegetable stuff) are all biodegradable materials.

Non-biodegradable waste materials

The waste materials that cannot be decomposed to simple, non-poisonous substances in the nature are called **non-biodegradable waste materials**. For example, plastic, polythene bags, synthetic fibres, glass objects, metal articles like aluminium cans, silver foils, certain detergents, fertilizers, pesticides like DDT and radioactive wastes.

Noise pollution

Noise pollution can be defined as unwanted or offensive sounds that unreasonably affect our daily activities. The unit of sound measurement is decibel (dB).

Major sources of noise pollution

❖ **Road traffic:** Road traffic noise is one of the most widespread and growing environmental problems.

❖ **Air and rail traffic:** In areas close to the airports and railway tracks, the sound of aeroplanes and trains are major sources of noise pollution.

❖ **Neighbourhood and domestic noise:** Barking dogs, car horns, loud music, TVs, loudspeakers, construction and household noise are some of the major sources of noise pollution.

❖ **Noise from industries:** At many places, industries are located in close proximity of the residential areas or within the residential areas. Sound of machines, etc., causes noise pollution.

Harmful effects of noise pollution

❖ Noise can affect human health and well-being in a number of ways, including annoyance reaction, sleep disturbance, interference with communication, performance effects, effects on social behaviour and hearing loss.

❖ Noise can cause annoyance and frustration as a result of interference, interruption and distraction.

❖ People experiencing high noise levels have increased number of headaches, greater susceptibility to minor accidents, increased reliance on sedatives and sleeping pills, and increased mental sickness.

❖ Exposure to noise is also associated with a range of possible physical effects including cold, changes in blood pressure, other cardiovascular changes, problems with the digestive system and general fatigue.

❖ Prolonged exposure to noise levels at or above 80 dB can cause deafness because of damage to the organ of Corti in the internal ear.

How to control noise pollution?

The noise pollution can be minimized in following ways.

❖ **Reduce the noise at its source** in industries and automobiles, etc.

❖ Try not to put the TV on high volume.

❖ **When playing music, turn it down at a reasonable level**. Better use headphones if you want to play your music loud or late at night.

❖ **Plant trees at roadsides**, curtains on the doors and windows, glass panes at the windows, etc., to **interrupt the path of the noise**. This will reduce the noise to some extent.

❖ **Do not unnecessarily blow horns**. This disturbs others.

❖ If the source of noise is unavoidable **cover your ears by hands or use ear plugs to avoid noise**.

Pollution due to radiation

The radioactive substances are generated due to nuclear activities in nuclear reactors and nuclear power plants.

The radiations from these radioactive substances harm human health and health of other flora and fauna. There are three types of radiations generated from nuclear activities.

1. Alpha particles which cannot penetrate human skin or a sheet of paper.

2. Gamma rays usually produced from cobalt source, which can penetrate human skin and harm body cells. Gamma rays are most harmful to human beings.

3. Beta rays, that can penetrate skin but not glass and metal. The source of radiation pollution are nuclear reactors, X-rays, nuclear power plants, radioisotopes, gamma chambers, radioactive ore mining.

Effects of radiation pollution

There are many effects of radiation pollution which may be short-term and long-term. The short-term effect may be skin burns and skin cancer. The long-term effect of radiation include gene damage by mutation in genes,cancer of intestine, bone marrow, gonads and spleen. Radiation can also cause loss of immunity, loss of hair and chromosomal abnormalities.

Swachh Bharat Abhiyan – A Mass movement to clean India

Swachh Bharat Abhiyan is a campaign launched by the government of India to make India a clean and green country.

It is India's largest ever cleanlisness drive. One of the key objectives of *Swachh Bharat Abhiyan* is to reduce or eliminate open defecation by constructing toilets. The government's objective is to make an Open Defecation Free (ODF) India by 2 October 2019, by constructing 12 million toilets in rural India. The government has allocated special budget for *Swachh Bharat Abhiyan*.

Swachh Survekshan

With an aim to foster a spirit of competition among the cities on cleanliness and assess their sanitation status, the government of India has started ranking cities on the basis of cleanliness surveys known as *Swachh Survekshan*.

The performance of each city is evaluated on key parameters like

- ❖ sweeping, collection and disposal of waste
- ❖ open defecation free / availability of toilets.
- ❖ capacity building and e-learning.
- ❖ provision for public and community toilets.
- ❖ information dissemination and behavioural change.

a. Green bin for wet or biodegradable waste.

b. Blue bin for dry or non-biodegradable waste.

SUMMARY...

❖ An undesirable change in the physical, chemical and biological characteristics of our surroundings that has harmed the human life and other living beings is known as pollution.

❖ Air pollution may be defined as the occurrence of foreign particles, gases and other materials in air which have adverse effects on biological communities and physical surroundings.

❖ Carbon monoxide, carbon dioxide, sulphur dioxide, fluorides, smog, aerosol spray propellants, oxides of nitrogen, suspended particulate matter, pesticides, and peroxyacetyl nitrate (PAN) are some common air pollutants.

❖ Water may be polluted by pesticides, chemicals, industrial and domestic waste, mineral and organic wastes, and radiation waste.

❖ Solid and agricultural waste, dead animals' carcasses, industrial waste and domestic garbage cause soil pollution.

❖ The waste materials that can be broken down or decomposed into non-poisonous substances by the action of microorganisms are called biodegradable materials.

❖ The materials that cannot be decomposed to non-poisonous substances in nature by the action of microorganisms are called non-biodegradable waste.

❖ Unwanted or offensive sound that unreasonably affects our daily activities is called noise pollution.

❖ Radiations from radioactive substances cause radiation pollution.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