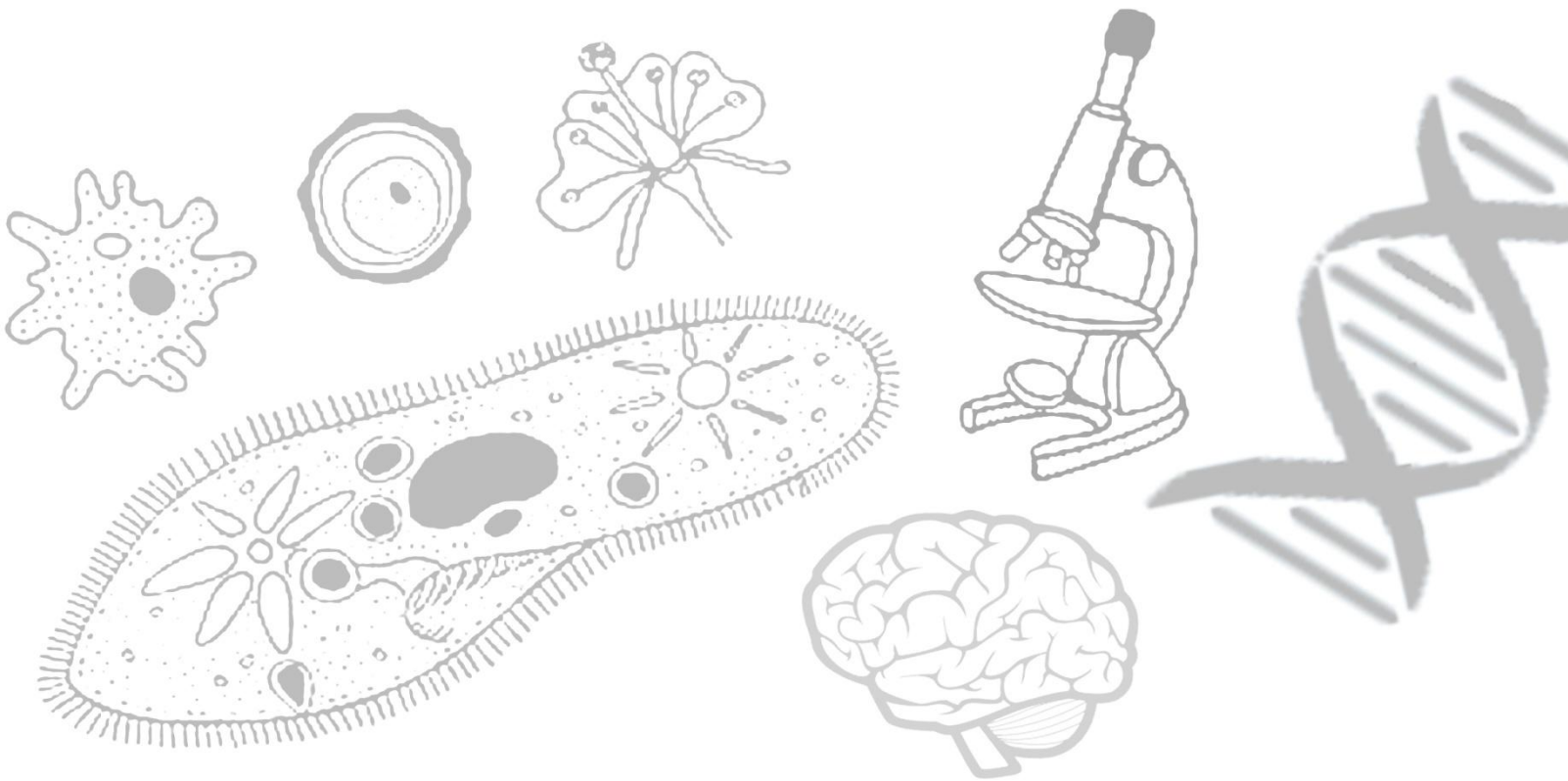


BIOLOGY



Environmental Issues

Pollution - Introduction

- **Pollution** is any undesirable change in the physical, chemical or biological characteristics of air, water or land which has the potential to adversely affect human life, life of desirable species, natural resources, industrial processes and cultural assets.
- **Pollutants** are substances released into the environment in large quantities because of natural or human activity and which have an adverse effect on plants, animals, man and the environment.
- The Government of India has passed the **Environment (Protection) Act, 1986** which aims to protect and improve the quality of air, water and soil.

Air Pollution

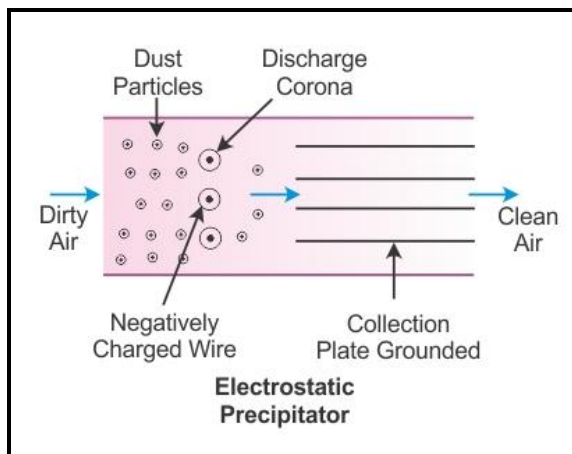
- The contamination of air with harmful gases such as carbon monoxide, sulphur dioxide and nitrogen oxide is called **air pollution**.
- Major air pollutants are Carbon monoxide (CO), carbon dioxide (CO₂), chlorofluorocarbons (CFCs), nitrogen oxide (NO), sulphur dioxide (SO₂), particulate matter and hydrocarbons.
- The effects of air pollution depend on the concentration of pollutants, the duration of exposure and the organism.
- Acid rain, smog, greenhouse effect and global warming, ozone depletion are some of the effects of air pollution.
- Air pollution affects health as well. It causes eye irritation; respiratory disorders; bronchitis and asthma; headaches; dizziness; nausea; decreased oxygen-carrying capacity of blood; anaemia; liver, kidney and brain damage; abnormal fertility and pregnancy; silicosis; byssinosis; asbestosis and black lungs.

Measures to Control Air Pollution

- There are two ways by which air pollution can be controlled – **control of particulate matter** and **control of gaseous pollutants**.

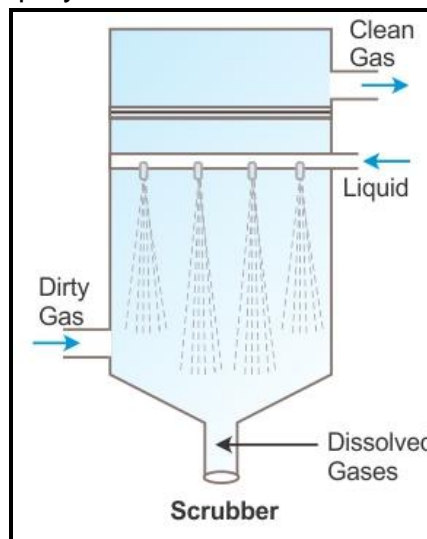
Electrostatic Precipitators

- Electrostatic precipitators remove about 99% of particulate matter present in the industrial and thermal power exhausts.
- The electrode wires are provided with high-voltage electric current which produce a corona that releases electrons.
- These electrons attach to the dust particles giving them a negative charge.
- The collecting particles are grounded and attract the charged dust particles.
- The velocity of air between the plates must be low enough to allow the dust to fall.



Scrubbers

- They are used to remove particulate matter and gases like sulphur dioxide.
- The exhaust is passed through a spray of water or lime to remove the pollutants.



Controlling Vehicular Air Pollutants: A Case Study of Delhi

- Because of the enormous number of automobiles in Delhi, the problem of air pollution was so serious that most of the Delhiites began to complain of burning eyes and respiratory discomfort.
- The Supreme Court directed the Government to take appropriate measures to reduce the pollution caused by automobiles:
 - Use of CNG for public transport
 - Phasing out of old vehicles
 - Compulsory use of unleaded petrol
 - Fitting of vehicles with catalytic converters
- The air quality of Delhi has improved with a substantial fall in the levels of SO₂, CO, NO_x between 1997 and 2005.

Noise Pollution

- According to the amendments of the Air (Prevention and Control of Pollution) Act in 1987, noise has been regarded as an **air pollutant**.
- Any disturbing sound of very high intensity leads to noise pollution.
- Noise has intensity of 80 dB and above. Noise becomes intolerable after 100 dB.
- Prolonged exposure to high-decibel noise damages the ear drums and can bring about permanent hearing impairment. It can also lead to high blood pressure.

Measures to Control Noise Pollution

- Blowing of horns should be prohibited.
- Use of loudspeakers should be banned.
- Airports should be located away from residential areas.
- Decibel metres should be installed at different places to monitor the level of noise pollution.
- Noise pollution control laws should be strictly implemented.

Water Pollution

- The contamination of water sources such as rivers, lakes, oceans and groundwater with unwanted and harmful substances which makes the water unfit for use by humans and other living beings is called **water pollution**.
- Household detergents, domestic sewage, industrial effluent, oil spills, discharge of fertilisers and pesticides, are the causes of water pollution.
- The Government of India passed the Water (Prevention and Control of Pollution) act, 1974 to safeguard the water resources.

Biochemical Oxygen Demand

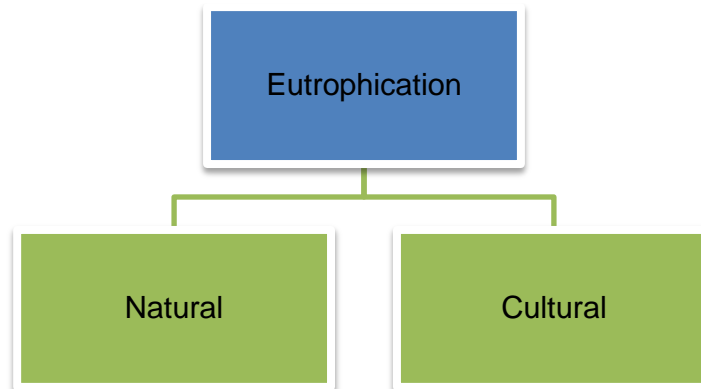
- The degree of impurity of water because of organic matter is measured in terms of biochemical oxygen demand (BOD).
- BOD is the oxygen in milligrams required to decompose the organic matter present in one litre of water at 20°C.
- Domestic sewage contains biodegradable organic matter which is readily decomposed by microorganisms.
- These microorganisms consume lot of oxygen during the process of decomposition.
- This causes a sharp decline in the dissolved oxygen making it unavailable for fish and other aquatic organisms. This causes mortality in aquatic organisms.

Algal Bloom

- Presence of large amount of nutrients causes excessive growth of algae over the surface of water. This is called **algal bloom**.
- This exponential growth keeps other underwater organisms refrained from the sunlight and oxygen which is harmful.

Eutrophication

- Eutrophication is the excessive growth of algae, plants and animals in water bodies because of nutrient enrichment particularly with nitrogen and phosphorus.



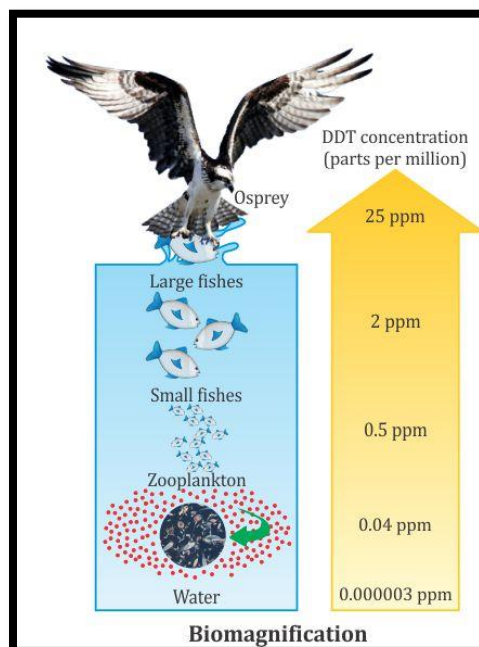
- Natural Eutrophication:** It is the nutrient enrichment of a water body because of natural ageing.
- Cultural Eutrophication:** It is the nutrient enrichment of water bodies because of human activities such as passage of sewage, industrial effluents and run off from fertilised fields rich in nitrates and phosphates.

Algal Bloom

- It is an example of cultural eutrophication.
- Presence of large amount of nutrients causes excessive growth of algae over the surface of water. This is called **algal bloom**.
- This exponential growth keeps other underwater organisms refrained from the sunlight and oxygen which is harmful.

Biomagnification

- The process by which harmful and toxic substances enter the food chain and get concentrated in the bodies of living organisms at each successive level in the food chain is called **biomagnification**.



- When DDT leaches from the agricultural field, it enters a nearby water body. The concentration of DDT in the water body is low (0.003 ppm).
- Its concentration increases along the food chain, reaching the highest level in the top carnivore bird.
- Increased concentration of DDT in birds disturbs calcium metabolism. Egg shells become thin, resulting in premature breaking. Consequently, there is a decline in the bird population.

Measures to Control Water Pollution

- Sewage, industrial waste and domestic waste should be treated to make them harmless before they are released into water bodies.
- Washing utensils, clothes and bathing cattle in water bodies must be avoided.
- Leakage in drainage pipes must be repaired.
- Awareness about the severity of water pollution must be created among students and adults.
- Laws should be formulated to control water pollution. Penalties should be enforced for those who break the law.

Integrated Wastewater Treatment: A Case Study

- An integrated wastewater treatment process was developed in the town of Arcata situated on the Northern Coast of California with the help of biologists from Humboldt State University.
- The treatment process consisted of two stages:
 - Conventional method of filtering, sedimentation and chlorine treatment for the removal of large organic remains, grit and microbes. The treated water contained huge amounts of heavy metals and other dangerous pollutants.
 - Innovative approach which consisted of developing a series of six connected marshes in 60 hectares of marshland seeded with bacteria, algae, fungi and plants.

Ecosan Toilets

- These are dry composting toilets.
- They can be used for the disposal of human excreta in an ecological way. No water is required in this toilet.
- Human excreta is converted into a resource as it forms a natural fertiliser. *Ecosan* toilets are functional in many parts of Kerala and Sri Lanka.

Solid Wastes

- **Solid waste** is defined as any solid unwanted material generated by human beings which needs to be discarded.
- The waste which is generated from domestic activities such as washing, bathing and cooking is called **domestic waste**. Examples: Kitchen waste such as fruit and vegetable peels and leftover food; waste paper, plastic, glass, rubber and metals
- The waste which is generated by industries is called **industrial waste**. Examples: Chemicals, paint residues, oil, ash, sludge, heavy metals

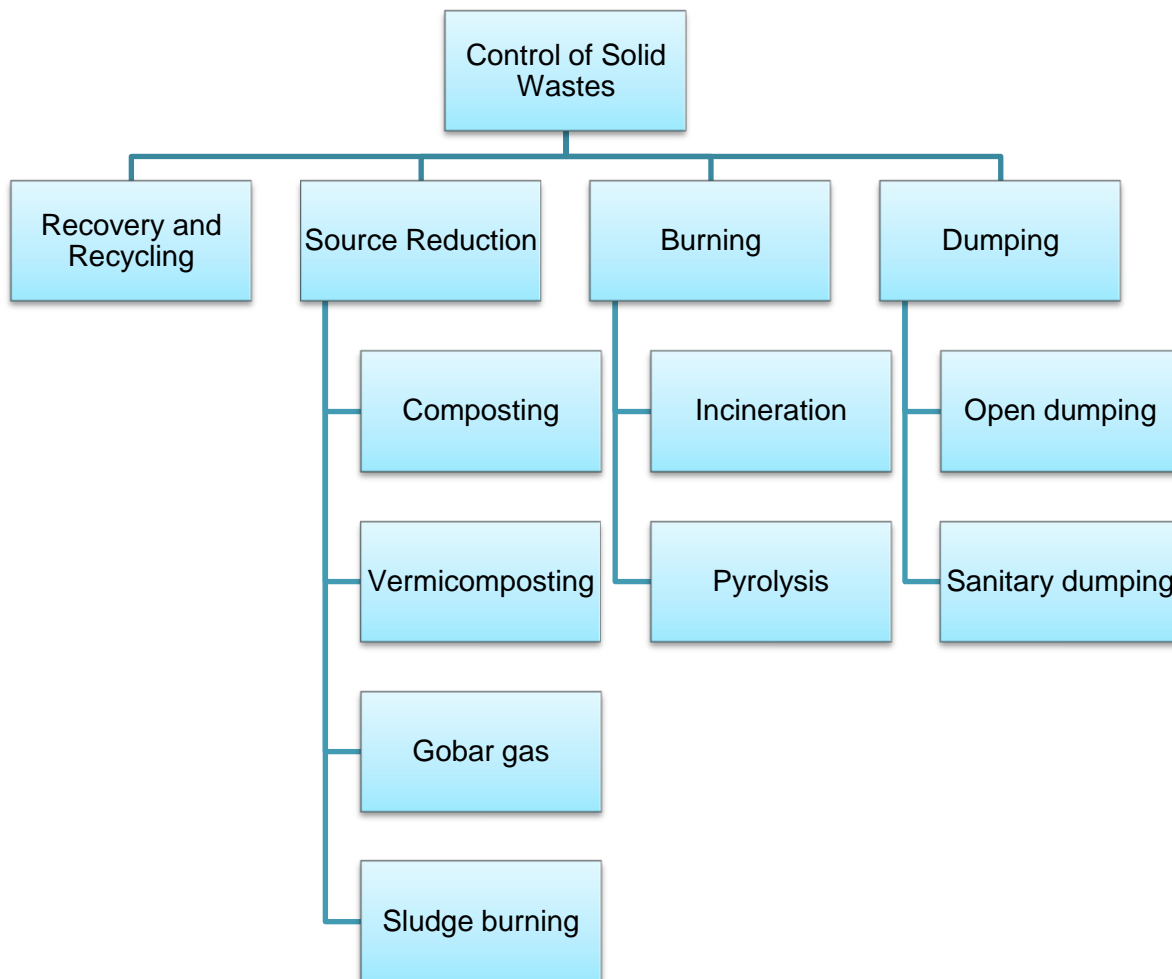
Domestic Waste	<ul style="list-style-type: none"> It is generated from domestic activities such as washing, bathing and cooking
Industrial Waste	<ul style="list-style-type: none"> It is generated by industries. Example: chemicals, paint residues
Hazardous Wastes	<ul style="list-style-type: none"> These wastes pose threat to the public and the environment. Exmample: paints, solvents
Agricultural Waste	<ul style="list-style-type: none"> Waste such as animal manure, plant leaves, bark and flowers which is generated from plants and animals is called agricultural waste.
Electronic Waste	<ul style="list-style-type: none"> It includes discarded electrical appliances such as old television sets, computers, radios, mobile phones, fluorescent tubes, medical instruments, toys and lead acid batteries.
Biomedical Waste	<ul style="list-style-type: none"> It is generated in hospitals and clinics
Urban Waste	<ul style="list-style-type: none"> It is municipal solid waste generated from domestic, industrial and commercial activities.
Wet Solid Waste	<ul style="list-style-type: none"> It is the waste which can be easily decomposed. Example: Vegetables, fruits, eggs, fish and meat
Dry Solid Waste	<ul style="list-style-type: none"> It is the waste which cannot be easily decomposed and needs to be reused and recycled
Biodegradable Waste	<ul style="list-style-type: none"> It can be disintegrated into non-poisonous substances by the action of microorganisms. Example: Spoilt food, vegetable peels
Non-biodegradable Waste	<ul style="list-style-type: none"> It cannot be disintegrated into harmless substances by any biological processes. Example: Glass bottles, metal cans

Effects of Improper Management of Solid Waste

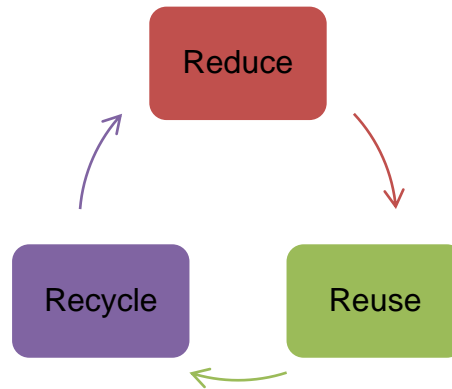
- Emission of bad odour
- Emission of toxic gases
- Spread of diseases
- Environmental pollution
- Water pollution
- Soil pollution

Control of Solid Wastes

- Disposal of solid waste involves the collection and categorisation of wastes, transport to the disposal site and disposal of waste.
- The various methods by which the disposal of solid waste is carried out given below:



Three Rs of Waste Management



- **Reduce:** Reduce the amount of Earth's resources.
- **Reuse:** The old goods can be reused to reduce the demand of the new goods.
- **Recycle:** Recycle the materials such as plastic, metals to reduce their accumulation in the environment.

Case Study of Remedy for Plastic Waste

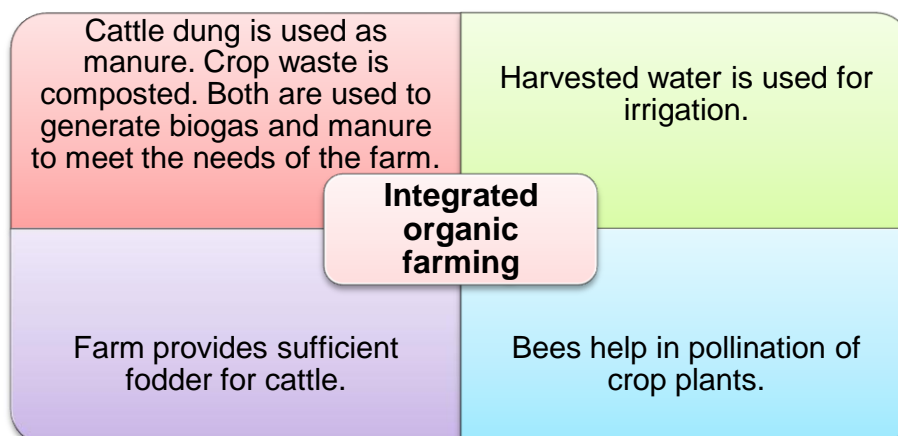
- Ahmed Khan, a plastic sack manufacturer of Bengaluru since 1986, realised that plastic waste was a serious problem and its recycling into sacks was not the only solution for its disposal.
- In 1998, he developed polyblend, a fine powder of recycled modified plastic.

Agrochemicals and their Effects

- With the Green Revolution, the use of agrochemicals i.e. inorganic fertilisers, pesticides, fungicides and herbicides has been increased.
- These agrochemicals may accumulate in the ecosystem and get biomagnified in the long run.
- They are toxic to the non-target organisms which are important component of the soil ecosystem. Hence, it is necessary to minimise their use.

Case Study of Organic Farming

- **Integrated organic farming** is a cyclic zero waste procedure of farming where waste from one process is cycled as nutrients for the next process.



Radioactive Waste

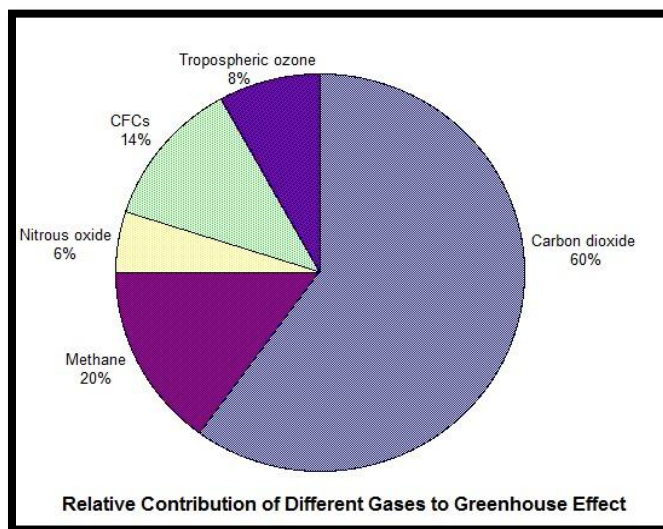
- **Radioactive wastes** are wastes which release radioactivity in the form of α -particles, β -particles or γ -rays from nuclides of their elements.
- X-rays, nuclear explosions, nuclear wastes are the sources of radioactive wastes.
- Radioactive wastes cause serious damage to the living world.

Measures to Control Radioactive Pollution

- Prevent leakage of radioactive substances from nuclear reactors.
- Strict measures should be followed in the construction and maintenance of nuclear power plants.
- All radioactive wastes should be disposed of safely.
- Strict control should be exercised over nuclear tests.

Greenhouse Effect

- The greenhouse effect is a natural process which warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected to space and the rest is absorbed and reradiated by greenhouse gases.
- Gases which are transparent to solar radiations but retain and partially reflect long-wave heat radiations are called **greenhouse gases (GHGs)**.
- The various greenhouse gases are carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_2O).



- In recent years, the concentration of greenhouse gases has increased, resulting in an enhanced greenhouse effect with a rise in the mean global temperature. It is called global warming.

Effects of Greenhouse Effect

- Increase in CO₂ concentration
- Global warming
- Odd climate and weather changes
- Changes in sea level
- Decline in species sensitive to higher temperatures
- Detrimental effects on the crop productivity

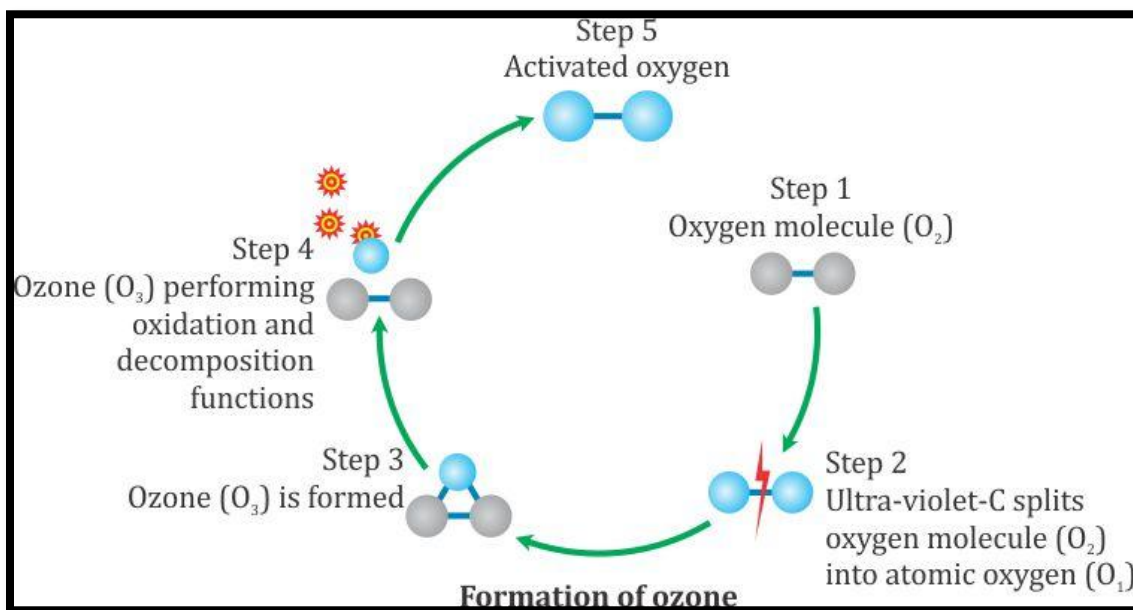
Global Warming

- Global warming is the increase in the Earth's average temperature because of the effect of greenhouse gases which trap the heat which would otherwise escape from the Earth's atmosphere.
- Rise in sea level, change in rainfall pattern, loss of biodiversity are some effects of the global warming.
- The global warming can be controlled by reducing the use of fossil fuels, reforestation, keeping a check on the population growth.

Ozone Depletion

- The ozone layer or the ozone shield called the ozonosphere is present in the **stratosphere** at an altitude of 23–25 km over the equator and at a slightly lower altitude of 11–16 km over the poles.
- Thickness of the ozone layer is measured in **Dobson units (D.U.)**.

Formation of Ozone



Causes of Ozone Depletion

- Compounds such as CFCs break down into chlorine atoms in the atmosphere. These chlorine atoms break down O₃ into oxygen (O₂) and nascent oxygen (O).
- The reduced amount of ozone cannot prevent the entry of UV rays.

- Depletion of the ozone layer widely in the stratosphere, particularly over the Antarctic region, resulted in the formation of a thinned ozone layer called the **ozone hole**.

Effects of Ozone Depletion

- Incidence of skin cancer, cataract and poor immune response in humans.
- Affects crop yield and productivity in plants.
- UV radiation can cause the death of phytoplankton, young fish and larval forms.
- UV radiations inhibit photosynthesis by affecting the photosynthetic machinery.
- UV-B damages DNA and can result in mutations.
- It causes ageing of skin, damage to skin cells and various types of skin cancers.
- In human eye, the cornea absorbs UV-B radiation. A high dose of UV-B causes inflammation of the cornea called **snow blindness** or **cataract**.

International Initiatives for Mitigating Global Changes

- Under the support of United Nations Environment Programme (UNEP), various efforts have been taken to find a solution for ozone depletion and global warming.
- **Montreal Protocol** came into effect on 16th September 1987.
- 27 industrialised countries agreed to minimise the production of CFCs to half the level of 1986.
- **Kyoto Protocol** came into effect in December 1997.
- The International Conference held in Kyoto, Japan, obtained commitments from different countries for reducing overall greenhouse gas emissions at a level 5% below the 1990 level by 2008–2012.

Improper Resource Utilisation and Maintenance

- Degradation of natural resources causes pollution.
- Improper utilisation and maintenance practices can also lead to degradation of natural resources.

Soil Erosion and Desertification

- It takes several hundreds of years for the development of fertile top soil.
- However, the activities such as deforestation, overgrazing, over-cultivation, leaving tilled soils without seedling and improper irrigation practices has led to the loss of fertile top cover. This makes the land barren.
- When large barren patches extend and meet over time, a desert is created. This is called **desertification**.

Waterlogging and Soil Salinity

- Improper practices such as excessive irrigation, kutchra irrigation channels, presence of impermeable underground soil pans and poor drainage result in water logging of soil.
- A waterlogged soil has poor aeration capacity because of which the plant growth is stunted.
- Evaporation of water draws salt to the soil surface.
- A crust of salt is formed both over the surface and upper layers of the soil.
- Such soils are called saline soils and are unsuitable for the growth of crops.

Deforestation

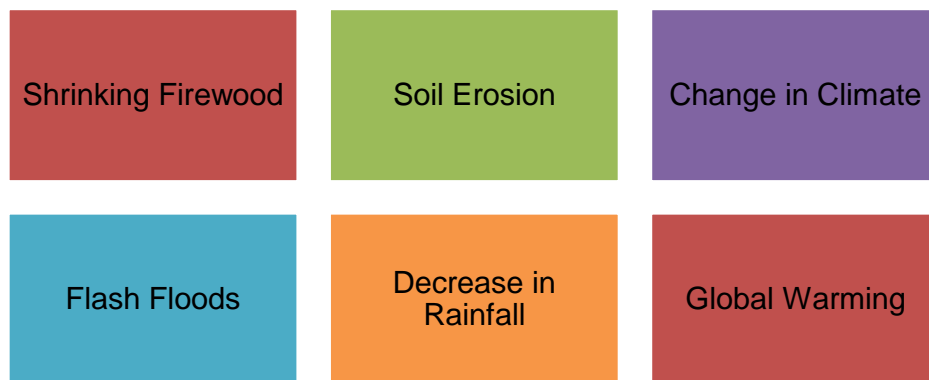
- **Deforestation** is the removal, decrease or deterioration of forest cover of an area.

Causes of Deforestation

- **Jhum Cultivation (Slash and Burn Agriculture):**
 - Huge tracts of land are cleared every year through lopping, burning the remainder, mixing the ash with soil and sowing the cleared land with crop seeds.
 - The land is used for 2–3 years without manuring which results in nutrient depletion, reduced moisture retention and increased soil erosion.
- Hydroelectric projects, forest fires, human establishments, construction of mountain and forest roads, construction of canals, overgrazing by animals, quarrying and mining are also the causes of deforestation.

Effects of Deforestation

Some of the effects of deforestation are as follows:



Measures to Conserve Forests

- **Afforestation and Reforestation:**
 - **Afforestation** is growing a forest cover over an area which was earlier devoid of trees.
 - **Reforestation** is restoring a forest cover over an area where one existed earlier but was removed at some point of time in the past.
- Degraded forests are regenerated through **silviculture** practices.
- Commercial forestry can be practiced. It is the plantation of useful trees and shrubs for meeting commercial requirements without causing any undue demand on natural forests.

People's Participation in Conservation of Forests

Khejri Trees and the Bishnois

- Conservation of forests and wildlife has been a religious belief for the Bishnoi community in Rajasthan.
- In 1731, Amrita Devi Bishnoi led a group of 363 people who sacrificed their lives for the protection of Khejri trees in Khejarli village near Jodhpur in Rajasthan.

The Chipko Movement

- The **Chipko Andolan** also called the 'Hug the trees movement' was organised to stop the destruction of forests. The movement began in 1970s in a remote village called Reni in Garhwal in the Himalayas.
- The women of the Reni village hugged the trees and protected from being axed by a contractor.

Joint Forest Management

- Under the guidelines issued in 1980s, village and tribal communities are involved in the development and protection of degraded forests on a share basis. It is called **joint forest management (JFM)**.
- Currently, there are 84,632 JFM communities with 17.33 million hectare forest area. About 85.28 lakh families are involved in JFM all over the country.