

UNIT 1: INTRODUCTION TO ENVIRONMENTAL SCIENCE

Definition of environment:

Environmental Protection Act (1986) defined environment as “the sum total of water, air, land and their interrelationship among themselves and with the human beings, other living beings and property.”

Definition of Environmental Science:

1. Environmental science is an interdisciplinary field that integrates scientific methods and disciplines to understand and address real world environmental challenges.
2. It is a systemic study of our environment and our place in it- mainly the abiotic and biotic components.
3. It is a comprehensive sum of all living and non-living things and their interactions.
4. It is an applied science as it seeks practical answers to making human civilization sustainable on the earth's finite resources.

Importance of Environmental Studies:

1. It is useful in checking environmental pollution and related solutions.
2. It helps in maintaining ecological balance.
3. It helps to gain skills to assess the environmental impact of human activities.
4. It will help to protect biodiversity.
5. It helps to achieve sustainable development.
6. It helps to educate people regarding their duties towards the protection of environment.

Current Environmental Problems:

Pollution

1. Air pollution
2. Water pollution
3. Noise pollution
4. Littering (spilling of oils in oceans)
5. Soil contamination (by lead, heavy metals)
6. Radioactive contamination
7. Thermal pollution
8. Visual pollution

Definition of Abiotic and Biotic Components:

Abiotic or non-living components of environment include all physical and chemical factors that influence living organisms. Eg, air, water, soil, rocks, etc.

Biotic or living components are the living beings present in an ecosystem. Eg, microbes, plants, animals and human beings.

Difference between Biotic and Abiotic Components:

FEATURE	BIOTIC	ABIOTIC
Definition	Living organisms in an ecosystem	Non-living physical and chemical factors
Roles in Ecosystem	Participate in food chains and energy flow	Influence the living conditions of organisms

Dependence	Depend on abiotic factors	Do not depend on biotic components for existence
Growth and Reproduction	Can grow, reproduce, and evolve over time	Do not grow, reproduce, or evolve
Examples	Plants, animals, fungi, bacteria	Sunlight, temperature, water, soil, air

Definition of Atmosphere: The atmosphere implies the protective blanket of gases, surrounding the earth.

Definition of Hydrosphere: The hydrosphere comprises all types of water resources oceans, seas, lakes, river, streams, reservoirs, polar icecaps, glaciers, and ground water.

Definition of Lithosphere: Lithosphere is the outer mantle of solid earth.

Definition of Biosphere: Biosphere indicates the realm of living organisms and their interactions with environments, viz, atmosphere, hydrosphere and lithosphere.

Definition of Development:

Gradual growth of a situation to a more advanced and stronger than previous one.

Development is unfolding of human potentials for meaningful participation in economic, social, political and cultural process and institutions, so that people can improve their conditions.

Definition of Sustainable Development:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

- **Gro Harlem Brundtland first introduced** the concept of sustainable development in **1987**.
- The UN established the **Commission on Sustainable Development (CSD)** in **December 1992** to follow up on UNCED and monitor Earth Summit agreements at all levels.
- The **Rio+5 Special Session (June 1997)** adopted a program for further implementing **Agenda 21** and set the CSD work program for **1997-2002**.
- The **Kyoto Protocol (December 1997)** and **COP conferences** have advanced efforts in financing and implementing sustainable development globally.

UNIT 2: NATURAL RESOURCES

Definition of Renewable Resources:

The resources which cannot be exhausted even after continuous utilisation are termed renewable resources. Eg, sun, wind, and tidal energy.

Definition of Non-Renewable Resources:

The resources which cannot be immediately replaced once they are depleted are called non-renewable resources. Eg, fossil fuels, such as coal, petroleum, natural gas and rare minerals typically found in meteorites.

Difference between Renewable and Non-Renewable Resources:

Features	Renewable Resources	Non-Renewable Resources
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Depletion	Cannot be depleted over time	Deplete over time
Sources	Sunlight, water, wind, and also geothermal sources (such as hot springs and fumaroles)	Fossil fuels such as coal and petroleum
Environmental impact	Low carbon emissions and low carbon footprint	Comparatively higher carbon emissions and carbon footprint
Infrastructure requirements	Infrastructure for harvesting renewable energy is prohibitively expensive and not easily accessible	Cost effective and accessible infrastructure is available for non-renewable energy
Area requirements	Large land / offshore area, especially for wind and solar farms	Comparatively lower area requirements

Forest Resources:

Forest resources play an important role in the economy of any country. It is highly complex, changing environments made up of a living and non-living things.

Forest varies a great deal of composition and density and are distinct from meadows and pastures.

Forests are important to humans and the natural world.

Forests provide fuel, wood, timber, wildlife, habitat, industrial, forest products, climate regulations, medicinal resources, etc.

Scientists estimate that India should ideally have 33 percent of its land under forests. Today we have only about 12 percent. Thus, we need not only to protect existing forests but also to increase our forest cover.

Forest Functions: (importance of forests)

1. Watershed protection:
 - a. Reduce the rate of surface run-off of water
 - b. Prevent flash floods and soil erosion
2. Atmospheric regulation:
 - a. Maintaining CO₂ levels for plant growth
 - b. Maintaining local climatic conditions
 - c. Absorption of solar heat during transpiration
3. Erosion control:
 - a. Holding soil (preventing rain from directly washing soil away)
 - b. Land bank- maintenance of soil nutrients and structure
4. Local / market use: (economical importance)
 - a. Food- plants, fishing, hunting
 - b. Fodder- cattle
 - c. Fuel wood and charcoal- cooking, heating
 - d. Poles- building homes
 - e. Timber- household articles, construction

Deforestation:

It is permanent destruction or exploitation of forests by humans for commercial and other purposes.

Causes: logging, mining, building dams, timber extraction, fuelwood dependency

- **National Forest Policy – 1988**

- **Joint Forest Management (JFM) – 1990**
- **New JFM Guidelines – 2000**
- **JFM Committees Data – 2002**

Effects:

1. Rise in temperature
2. Less precipitation
3. Increased rate of soil erosion
4. Loss of soil productivity, biodiversity
5. Imbalance in ecosystem

Control of Deforestation:

1. Prevention of human settlement in forest areas
2. Check on expansion of agriculture into forest lands
3. Prohibition of setting up of agriculture into forest lands
4. Check on reckless cutting of trees
5. Controlled mining in forest areas
6. Check on construction of large dams in forest areas
7. Control on over grazing in forest areas

Difference between Afforestation and Deforestation:

Afforestation	Deforestation
Afforestation is the planting of trees in an area where there was no tree cover previously.	Deforestation is the destruction of trees and forests for human habitation and use.
Afforestation has a beneficial effect on the environment.	Deforestation has a detrimental effect on the environment.
The main reason for afforestation is to control carbon footprint and to ensure the sustainability of the natural environment.	Deforestation is a result of industrialization, globalization and urbanization.

Mining:

The extraction of the minerals and their ores from the earth's interior so that they can be used. This process is known as mining.

- Mines are of two types surface or under-ground mines.
- Mining is hazardous occupation, and the safety of the mine workers is important.
- Surface mining is less hazardous than underground mining.
- Metal mining is less hazardous than coal mining.
- Mining possesses several long-term occupational hazards to the miners. Dust produced during mining operations is injurious to health and causes a lung disease known as black lung.
- Fumes generated by incomplete dynamite explosions are extremely poisonous.
- Radiation is hazardous in uranium mines.

UNIT 3: ECOSYSTEM

Definition of Ecosystem:

The term 'eco' refers to a part of the world and 'system' refers to the coordinating units. The term ecosystem is first given by A.G. Tansley.

An ecosystem is a community of organisms and their physical environment interacting together. Environment involves both living organisms and the non-living physical conditions. These two are inseparable but inter-related. The living and physical components are linked together through nutrient cycles and energy flows.

Ecosystem:

1. Terrestrial- eg, forest, grassland and desert
2. Aquatic- eg, pond, lake, wetland, river and estuary
1. abiotic- eg, soil, water, light, inorganic nutrients and weather
2. biotic- eg, producers and consumers

Biotic Components of Ecosystem:

1. Producers
2. Consumers
3. Decomposers

Definition of Stratification:

The vertical distribution of different species occupying different levels is called stratification.

Eg, trees occupy top vertical strata or layer of a forest, shrubs the second, herbs and grasses occupy the bottom layers.

BHOPAL GAS TRAGEDY

The **Bhopal Gas Tragedy** remains one of the most devastating industrial disasters in history. It occurred on the night of **December 2-3, 1984**, in **Bhopal, Madhya Pradesh, India**, when a highly toxic gas, **methyl isocyanate (MIC)**, leaked from the **Union Carbide India Limited (UCIL) pesticide plant**. This tragic incident led to the loss of thousands of lives, severe health complications for survivors, and long-lasting environmental damage.

Cause:

The Union Carbide plant in Bhopal manufactured pesticides using MIC, a highly volatile and toxic chemical. On the fateful night, water inadvertently entered a MIC storage tank, triggering an exothermic reaction. This caused the pressure in the tank to rise, leading to the release of **approximately 40 tons** of MIC gas into the atmosphere. Due to inadequate safety measures, including non-functional safety systems, the toxic gas spread quickly over the densely populated areas surrounding the plant.

Effect:

The tragedy had profound and lasting effects on the survivors and the environment. Many victims continue to suffer from chronic illnesses, including respiratory issues, eye disorders, and genetic defects in subsequent generations. Contaminated groundwater and soil in the affected areas have posed ongoing health hazards, with toxins still present decades after the disaster.

Conclusion:

The Bhopal Gas Tragedy highlighted the importance of **industrial safety, corporate accountability, and environmental regulations**. It led to stricter safety laws in India and globally, including the **Environment Protection Act of 1986**. However, the struggle for justice and proper rehabilitation for survivors continues.