

UNIT-I

Environmental Education

The word 'Environment' is derived from the French word 'Environner' which means to encircle, around or surround.

According to Boring, "A person's environment consists of the sum total of the stimulation which he receives from his conception until his death". Indicating that environment comprises various types of forces such as physical, intellectual, mental, economical, political, cultural, social, moral and emotional.

Douglas and Holland defined that "The term environment is used to describe, in aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms".

Environment is a complex of many variables, which surrounds man as well as the living organisms. Environmental studies describe the interrelationships among organisms, the environment and all the factors, which influence life on earth, including atmospheric conditions, food chains, the water cycle, etc. It is a basic science about our earth and its daily activities, and therefore, this science is important for one and all. Scope of environmental studies Environmental studies discipline has multiple and multilevel scopes. This study is important and necessary not only for children but also for everyone.

Scopes of Environmental Education

1. The study creates awareness among the people to know about various renewable and nonrenewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.
2. It provides the knowledge about ecological systems and cause and effect relationships.
3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganisms in the environment.

4. The study enables one to understand the causes and consequences due to natural and main induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.
5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.
6. The study enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.
7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.
8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.
9. It teaches the citizens the need for sustainable utilization of resources as these resources are inherited from our ancestors to the younger generating without deteriorating their quality.
10. The study enables theoretical knowledge into practice and the multiple uses of environment.

Importance and Need For Environmental study/education

Environmental study is based upon a comprehensive view of various environmental systems. It aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems. The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and anthroposphere.

- World population is increasing at an alarming rate especially in developing countries.
- The natural resources endowment in the earth is limited.
- The methods and techniques of exploiting natural resources are advanced.
- The resources are over-exploited and there is no foresight of leaving the resources to the future generations.
- The unplanned exploitation of natural resources lead to pollution of all types and at all levels.
- The pollution and degraded environment seriously affect the health of all living things on earth, including man.

- The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.
- Education and training are needed to save the biodiversity and species extinction.
- The urban area, coupled with industries, is major sources of pollution.
- The number and area extinct under protected area should be increased so that the wild life is protected at least in these sites.
- The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- The study motivates students to get involved in community action, and to participate in various environmental and management projects.
- It is a high time to reorient educational systems and curricula towards these needs.
- Environmental studies take a multidisciplinary approach to the study of human interactions with the natural environment. It integrates different approaches of the humanities, social sciences, biological sciences and physical sciences and applies these approaches to investigate environmental concerns.
- Environmental study is a key instrument for bringing about the changes in the knowledge, values, behaviors and lifestyles required to achieve sustainability and stability within and among countries.

Environmental studies deals with every issue that affects an organism. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human impacts on its integrity. It is an applied science as it seeks practical answers to making human civilization sustainable on the earth's finite resources. Its components include:

- | | | | |
|----------------|----------------|----------------|-----------------|
| 1. Biology | 2. Geology | 3. Chemistry | 4. Physics |
| 5. Engineering | 6. Sociology | 7. Health | 8. Anthropology |
| 9. Economics | 10. Statistics | 11. Philosophy | |

Type and Components of Environment

The environment has three important constituents. These are:

- (a) Physical
(b) Biological
(c) Social

(a) The Physical Constituent of environment includes soil, water, air, climate, temperature, light etc. These are also called abiotic constituents of the environment. This part of the environment mainly determines the type of the habitat or living conditions of the human population. This physical constituent of the environment is again divided into three parts. **These are:**

- (i) Atmosphere (gas) (ii) Hydrosphere (liquid) (iii) Lithosphere (solid)

b) The biological constituent of environment is also called biotic component of environment. This component consists of all living things like plants, animals and small micro-organisms like bacteria. This component interacts with the abiotic component of the environment. This interaction of two components forms various ecosystems like pond ecosystem, marine ecosystem, desert ecosystem etc. The self sufficient large ecosystem of the earth is called Biosphere. All ecosystems consist of three different types of living organisms. These three types are named as:

- (a) Producers
(b) Consumers
(c) Decomposers

Producers are generally green plants and other photosynthetic bacteria which produces various organic substances such as carbohydrates, proteins etc. with the help of water, soil and light energy. Consumers depend for their nutrition on the organic food produced by the green plants. Decomposers bring about the decomposition of dead plants and animals and return various important minerals for the running of the biogeochemical cycles.

c) The social constituent of environment mainly consists of various groups of population of different living organisms like birds, animals etc. Man is the most intelligent living organism. Like other living creatures, man builds house, prepares food and releases waste materials to the environment. Man is a social animal as told by Greek philosopher, Aristotle. He makes various laws, policies for the proper functioning of the society.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Environmental Impact Assessment (EIA) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.

Although legislation and practice vary around the world, the fundamental components of an EIA would necessarily involve the following stages:

- a. *Screening* to determine which projects or developments require a full or partial impact assessment study;
- b. *Scoping* to identify which potential impacts are relevant to assess (based on legislative requirements, international conventions, expert knowledge and public involvement), to identify alternative solutions that avoid, mitigate or compensate adverse impacts on biodiversity (including the option of not proceeding with the development, finding alternative designs or sites which avoid the impacts, incorporating safeguards in the design of the project, or providing compensation for adverse impacts), and finally to derive terms of reference for the impact assessment;
- c. *Assessment and evaluation of impacts and development of alternatives*, to predict and identify the likely environmental impacts of a proposed project or development, including the detailed elaboration of alternatives;
- d. *Reporting the Environmental Impact Statement (EIS) or EIA report*, including an environmental management plan (EMP), and a non-technical summary for the general audience.
- e. *Review of the Environmental Impact Statement (EIS)*, based on the terms of reference (scoping) and public (including authority) participation.

- f. *Decision-making* on whether to approve the project or not, and under what conditions; and
- g. *Monitoring, compliance, enforcement and environmental auditing*. Monitor whether the predicted impacts and proposed mitigation measures occur as defined in the EMP. Verify the compliance of proponent with the EMP, to ensure that unpredicted impacts or failed mitigation measures are identified and addressed in a timely fashion.

Environment vs Ecology

<i>Environment</i>	<i>Ecology</i>
Environment refers to the interaction between the physical, chemical and biological components.	Ecology is the study of relationship between organisms and their environment.
The environmental issues include pollution, deforestation, global warming, and other broader issues.	The ecological issues include population size, diversity, distribution of organisms, and also the competition between them.
Studies the internal and external factors affecting the environment.	Aims to understand life process, distribution, adaptation and biodiversity.

Ecosystem

Branch of science concerned with plant & animal relationship with their environment is termed as Ecology.

Plants, animals & microorganisms together with environment in which they live, make up an independent unit, called Ecosystem.

Basic Principles of Ecology

1. All living beings & their physical environment are interdependent & affect each other.
2. An alteration of any 1 component affects all other components of environment.
3. Environment is modified by living beings according to their needs.
4. Every organism has certain limits of tolerance towards environment. An organism can survive only within these limits.
5. Existence of life depends upon flow of energy & on cycling of nutrients. These processes ensure stability of an ecosystem.
6. In an ecosystem, greater variety of organisms leads to its stability.

Components of an Ecosystem

1. Abiotic Component: These are the non-living components.

a) *Inorganic Component*- Inorganic compounds & elements are included in this category such as Ca, S, P, CO₂, H₂O, etc.

b) *Organic Component*- It includes organic compounds such as carbohydrates, proteins, amino acids, etc. These are the connections between abiotic & biotic components.

c) *Climatic Component*- Light, temperature, soil, wind, etc.

2. Biotic Component: It composes of all living organisms.

a) *Producers*- Autotrophic plants are main producers. Capable of synthesizing food from non living components. In it Chemo-synthesis bacteria are also included.

b) *Consumers*-

(i) Primary:- Also known as Herbivores. Eg. Insects, Grasshopper, Rabbit, Deer, etc.

(ii) Secondary:- They depend upon primary consumers. Eg. Dog, Cat, Fox, Wolf, etc.

(iii) Tertiary:- They feed upon secondary consumers. They are known as secondary carnivores. Eg. Lion, Tiger, etc.

3. Decomposers: They depend upon dead bodies of producers & consumers & decompose them into simple inorganic molecules. Eg. Bacteria, fungi, etc.

Types of Ecosystem

1. Natural

Types of Natural Ecosystem

(A) Terrestrial ecosystem

(i) Forest Biomes

(ii) Desert biomes

(iii) Grasslands

(iv) Alpine biomes

(B) Aquatic ecosystem

(i) Fresh Water

(ii) Marine ecosystem

(a) Lotic (Running water) - River, spring

(b) Lentic (still water) - lake, pond

2. Man-made

Natural ecosystem vs. Man-made system

<i>Natural ecosystem</i>	<i>Man-made Ecosystem</i>
Consists of many species of plants and animals.	Species diversity is low.
Genetic diversity is very high.	Genetic diversity is very low.
Sunlight is the energy source for plants and this energy drives all biological cycles	Sunlight is the ultimate energy source for plants but artificial fertilizers and other nutrients are externally supplied to the soil
Food chains are long and complex	Food chains are simple and often incomplete as other species are killed as pests or weeds
Ecological succession takes place over time	No ecological succession
Natural nutrient cycling	Incomplete nutrient cycling
Naturally sustainable	Unsustainable as most fertilizers are made from non-renewable fossil fuels, and they add to water pollution, biomagnifications and other ecological disturbance

Energy flow Through an Ecosystem

Ecological kinship is energy oriented. It moves in ecosystem starting from Plants ----> Heterotrophs ----> Consumer ----> Carnivore relationship. It means energy is transferred from one trophic level to other in succession in form of a chain termed as Food Chain.

Food Chain

Transfer of food energy from source in plants through a series of organisms by repeated eating & being eaten up is known as Food Chain.

Predator chain: Starts from plant base & goes from smaller to larger animals.

Parasite Chain: Goes from larger to smaller animals.

Saprophytic Chain: Goes from dead matter to microorganisms.

Two types of Food Chain

1. Grazing Food Chain:

Autotroph ----> Herbivores ----> Primary carnivore ----> Secondary carnivore.

2. Detritus Food Chain: Organic wastes derived from grazing food chain are termed as Detritus. The detritivores ingest decomposed organic matter, digest them partially & after extracting chemical energy for their metabolism

Plants ----> Insects ----> Frog ----> Snake

Food Web

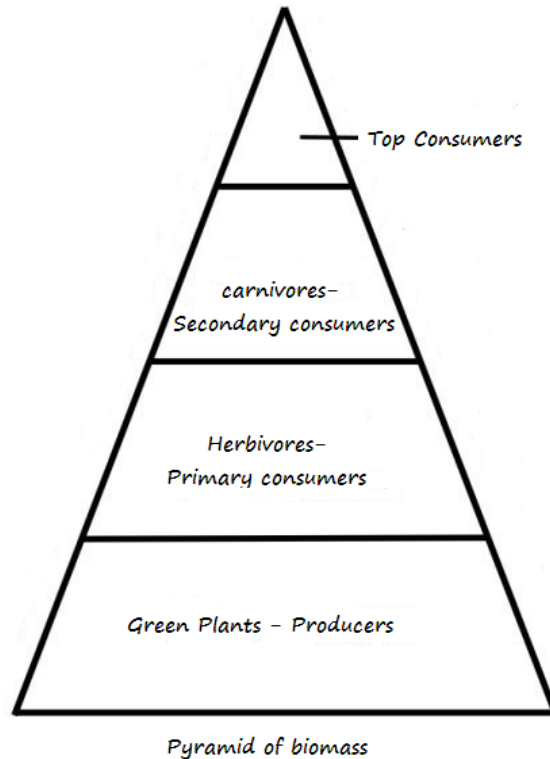
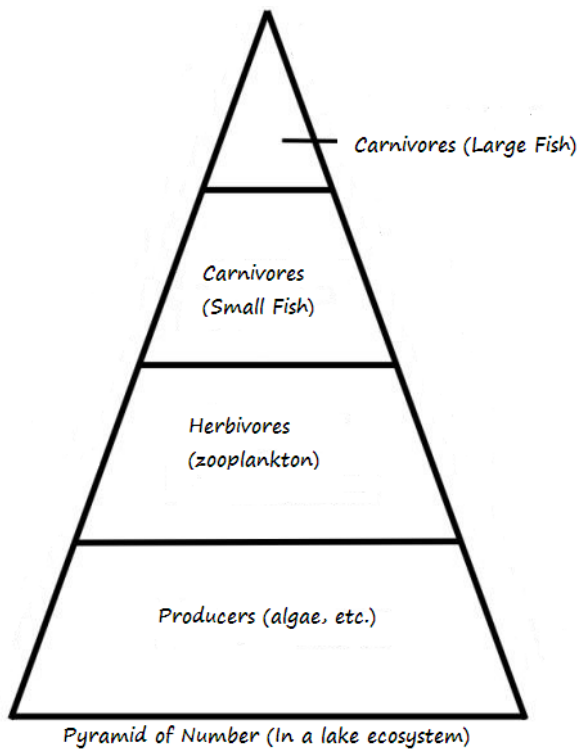
Actual consumption of food in a natural ecosystem is Food Web. Size of food, availability of food & age of organism determine this relationship. Thus; we can say that varied food chains are linked & interact with each other forming a Food Web.

Ecological Pyramids

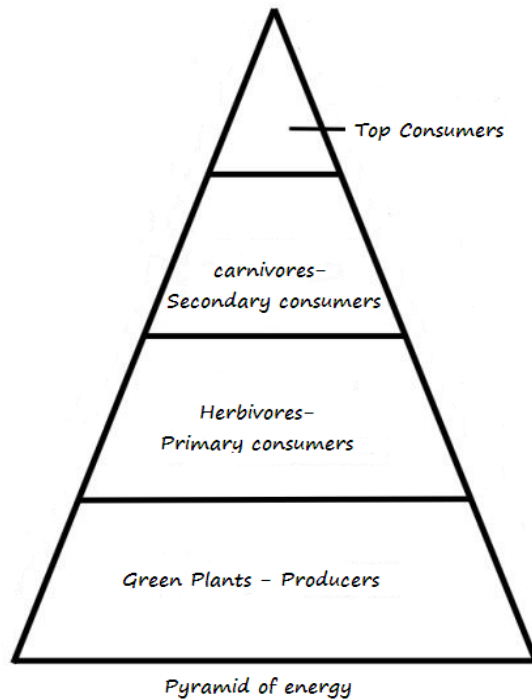
Producers ----→ Herbivores ----→ Carnivores is known as Ecological Pyramid.

Types of Ecological Pyramids

1. Pyramid of numbers: In it, smaller animals are preyed upon larger animals & smaller animals increase faster in number. Relative decrease in no. of organisms at each stage of Food Chain when put in a graph with size group makes a triangular figure known as Pyramid of Numbers.



2. Pyramid of Biomass: Total dry weight; calorie value or the other measurements of total living material at one time in a food chain forms a pyramid of biomass. For e.g., total biomass of producers is more than herbivores which is again more than carnivores.



3. Pyramid of Energy: It shows rate of energy flow at different trophic levels. When production of a community is measured in term of energy, we find that a pyramid is formed from Producers to Consumers.

Ecological Efficiency

Ratio between total energy assimilated & energy utilized within one trophic level of a food chain is Ecological Efficiency.

UNIT II

NATURAL RESOURCES

Natural resources are living things from the Earth that living things need. Components of environment which are useful and necessary for life (for survival, comfort & prosperity).

Types of Natural Resources

a) On basis of their Long Term Usage:

1. *Renewable* (Inexhaustible) For e.g. Solar, Wind, Geothermal, Wave Energy, etc.
2. *Non-Renewable* (Exhaustible) For e.g. Coal, Petroleum, Natural gas, Nuclear Power, etc.

b) On basis of Origin:

1. *Biotic* (Organic Resources): Obtained from biosphere (e.g. Forests, Birds, Animals, Minerals, Oils, etc.)
2. *Abiotic* (Inorganic Resources): Composed of non-living inorganic matter (e.g. Land, Water, etc.)

FOREST RESOURCES

The word forest is derived from a Latin word “Foris” means “Outside”. A variety of forests in India can be distinguished from each other on basis of:

1. Annual rainfall
2. Humidity
3. Vegetation
4. Their allocation (Areas where they are found)

Types of Forests in India:

Tropical Evergreen Forests

Rainfall >200cm.

Humidity 77%.

Common Trees: Mahogany, Ivory Wood, Ebony & Rubber.

Dry Tropical Forests

Rainfall 90-120 cm.

Humidity 50-60%.

Common Trees: Teak, Rosewood, Amaltas

Riparian Forests

Rainfall <50 cm.
Common in Wet places.
Common Trees: Neem, Babool, Pipal

Sub Tropical Broad Leave Hill Forests

Rainfall 75-125 cm.
Humidity 80%.
They are evergreen.

Alpine Forests

Found in Himalayas at ht. of 2880-3770 m.
Common Trees: Dwarf shrubs, Fir, Pine.

Mountain Wet Temperate Forests

Rainfall 150-300 cm.
Temp. 11-14 degrees.
Common Trees: Oak, Magnolia, Deodar

Mountain Moist Temperate Forests

Found in Eastern & Western Himalayas.
Common Trees: Oak, Birch, Silverfish

Grass land

Low land grasslands: Punjab, UP, Haryana.
Upland grass lands: At ht. of 1km.
Riverline Grass lands: Around rivers/coastal areas.

Advantages/Uses of Forests or Functions of Forests:

Protective Function:

Forests provide protection against: Soil erosion, Droughts, floods, Noise, Radiations

Productive Function:

Forest Provide various products like: Gum resins, medicines, honey, pulp, bamboo, timber and fruits.

Accessory Function:

Forest provides aesthetics, habitat to various flora and fauna besides that it also has an recreational value.

Regulative Function:

The Forest regulates the level of Oxygen and carbon dioxide in atmosphere by means of 'Photosynthesis'. The forests also help in regulating temperature conditions.

Forest play a crucial role in regulation of global climate and temperature as forest cover absorb the solar radiations that would otherwise be reflected back into the atmosphere by bare surface of the earth.

Transpiration of plants increases the atmosphere humidity which affects the rainfall, cools the atmosphere and thus regulates the hydrological cycle.

Some National Parks in India

Kaziranga (Assam), Gir (Gujrat), Himalayan (Himachal Pradesh), Bandipur (Karnataka), Kanha (M.P.), Ranthambore (Rajasthan), Corbett (Uttaranchal), Sunderban (West Bengal), Dudwa (Uttar Pradesh).

Deforestation:

The permanent destruction of forest is called deforestation.

Causes of Deforestation:

1. Population Explosion
2. Shifting Cultivation
3. Growing Food Demand
4. Firewood
5. Raw Material for wood based Industry
6. Infrastructure Development (Varied Engineering Projects including building of dams, highways, etc.)
7. Forest Fires
8. Overgrazing
9. Natural Forces (Storms, floods, etc.)

Effects of Deforestation:

1. Soil Erosion
2. Expansion of deserts
3. Decrease in rainfall
4. Loss of fertile Land
5. Effect on climate Global Warming
6. Lowering of Water Table
7. Economic losses
8. Loss of Biodiversity
9. Environmental changes

Afforestation

The conservation measure against the deforestation is afforestation. The development of forest by planting trees on waste land is called afforestation. The main objectives of afforestation are:

1. To control the deforestation.
2. To prevent soil erosion.
3. To regulate rainfall and maintain temperature

Afforestation can be achieved by:

1. Use of alternative Energy Resources.
2. Encouragement for plantation through some rewards.
3. Well Designed policy for urbanization control.
4. NGOs to be encouraged for Awareness program.
5. Govt. should start social movements like 'Chipko' Movement.

WATER RESOURCES

While 67% of Earth's surface is covered by water, only less than 2.7% of global water is fresh water. Most of the fresh water (2.05%) are locked in ice caps and glaciers. Only less than 0.7% is available for humans.

Surface Water

Streams, rivers, lakes, ponds, reservoirs, wetlands are examples of Surface Water. Runoff replenishes surface water.

Groundwater

Water held underground in the soil or in pores and crevices in rock. Supply of fresh water found under Earth's surface-recharged when water at surface infiltrates into the ground and are stored in underground aquifers.

Some Terminologies:

1. *Watershed*: Area of land drained by a single river.
2. *Infiltration*: Process of water percolating through the soil and into cracks and permeable rocks.
3. *Zone of Aeration*: Upper soil layers that hold both air and water.
4. *Zone of Saturation*: Lower soil layers where all spaces are filled with water.
5. *Water Table*: Top of zone of saturation.

Water Rights

- a) Water collectively belongs to the public, cannot be owned by individuals.
- b) Individuals or groups may be granted rights to use water.
- c) Legal authorization to use a predefined quantity of public water for a designated purpose such as irrigation, domestic water supply, power generation.
- d) State law requires certain users of public waters to receive approval from the state prior to using water.
- e) Any use of surface water which began after 1917 requires a water-right permit.
- f) Withdrawals of underground water from 1945 requires a water-right permit.

Threats to Fresh Water Resources

- a) Climate change causes change in frequencies of droughts and floods.
- b) Depletion of aquifers caused by over-consumption as a result of population growth.
- c) Pollution and contamination by sewage, agricultural and industrial runoff.

Problems related to Water crisis

- a) Inadequate access to safe drinking water by 1.3 billion people.
- b) Groundwater over-drafting leading to diminished agricultural yields.
- c) Overuse and pollution of water resources harming biodiversity.
- d) Regional conflicts over scarce water resources sometimes resulting in warfare.

The Ultimate Solution- “Desalination “

Desalination of sea water can be done either via distillation or membrane process. Both process requires large amount of energy and thus costly. Thus, desalination remains an expensive option for providing reliable fresh water supply, restricted to only economically well-off countries.

Water Induced & Water Borne Diseases

Water induced diseases are related to unclean water like heavy metals, nitrogen from fertilizer runoff, pesticides, etc.

Water borne diseases spread through water contaminated with human or animal faeces (including food and utensils, which have been washed with the contaminated water and dirty hands).

1. CHOLERA

- An acute diarrheal disease, caused by *Vibrio cholerae*.
- In the severe form, Painless watery diarrhea and copious effortless vomiting occurs, leading to hypovolemic shock and death within 24 hours.
- If treated early, then the disease lasts for around 4-6 days , during which the patient loses huge amounts of liquids and electrolytes from his body.

Prevention & Control:

- Hygiene education
- Good nutrition
- Good sanitation
- Water related issues should be addressed immediately
- Public health infrastructure is of utmost importance to control outbreaks
- Avoid contacting soils that may be contaminated with feces
- Do not defecate outdoors ~ rural areas
- Wash /Sanitize our hands before eating
- While travelling to places with poor sanitation, avoiding contaminated water.

2. Typhoid: Also known as “Enteric Fever”/ “Bilious Fever” and “Yellow Jack”.

- Typhoid fever is caused by *Salmonella typhi*.
- The term ‘Enteric fever’ consists of both typhoid and paratyphoid fever.
- Typhoid was once not demarcated from normal fevers, but a detailed study of the diseases was given by Bretonneau, 1826 – identified the intestinal lesions.
- Louis gave the name ‘Typhoid’ in 1829

Symptoms:

- Diarrhea
- Severe headache
- Abdominal pain
- Anorexia
- Fever
- Ulcers on intestinal wall
- Shock
- Rose spots
- Intestinal hemorrhage + perforations.

Control & Prevention:

- Simple hand hygiene and washing can reduce several cases of typhoid.
- Choose processed foods for safety

- All milk and dairy products should be pasteurized.
- Control fly populations
- Any bleeding from rectum, bloody stools, sudden acute abdominal pains should be reported at once to the physician.

Energy Resources

1. Conventional Energy Resources (Non-Renewable Resources):

(a) Nuclear Energy (Fusion & Fission):

Advantages:

- Produces no polluting gases.
- Does not contribute to global warming.
- Very low fuel costs.
- Low fuel quantity reduces mining and transportation effects on environment.
- High technology research required benefits other industries.
- Power station has very long lifetime.

Disadvantages/Limitations:

- Waste is radioactive and safe disposal is very difficult and expensive.
- Local thermal pollution from wastewater affects marine life.
- Large-scale accidents can be catastrophic.
- Public perception of nuclear power is negative.
- Costs of building and safely decommissioning are very high.
- Cannot react quickly to changes in electricity demand.

(b) Natural gas:

Advantages:

- Natural Gas is Environmentally Clean.
- It is Economical.
- It is Convenient.
- Natural Gas is Safe to Use.
- It is Available Abundantly.
- It is more efficient.
- Natural Gas is Easy to Deliver.

Disadvantages/Limitations:

- Limited Quantities.
- Natural Gas is Highly Combustible.

- Natural Gas is a Non-Renewable Source of Energy.
- Natural Gas Emits Carbon Dioxide.
- Long Processing Process.
- Leakage.
- Storage.

(c) Coal:

Advantages:

- It is available in an abundant supply.
- It has a high load factor.
- Coal offers a rather low capital investment.
- Carbon capture and storage technologies can reduce potential emissions.
- It can be converted into different formats.
- Coal can be used with renewables to reduce emissions.
- It is a full-time energy resource.

Disadvantages/Limitations:

- It is not a renewable resource.
- Coal contains a high level of carbon dioxide per British Thermal Unit.
- Coal power can create high levels of radiation.
- Coal emissions are linked to health concerns.
- Even clean coal still has high levels of methane.
- Coal mines cause relocation and destruction.

2. Non-Conventional Energy Resources (Renewable Resources):

(a) Solar Energy:

Advantages:

- Solar power is pollution free and causes no greenhouse gases to be emitted after installation.
- Reduced dependence on foreign oil and fossil fuels.
- Renewable clean power that is available every day of the year, even cloudy days produce some power.
- Return on investment unlike paying for utility bills
- Virtually no maintenance as solar panels last over 30 years.
- Creates jobs by employing solar panel manufacturers, solar installers, etc. and in turn helps the economy.
- Excess power can be sold back to the power company if grid intertied

- Ability to live grid free if all power generated provides enough for the home/building.
- Can be installed virtually anywhere; in a field to on a building.
- Use batteries to store extra power for use at night.
- Solar can be used to heat water, power homes and building, even power cars.
- Safer than traditional electric current.
- Efficiency is always improving so the same size solar that is available today will become more efficient tomorrow.
- Aesthetics are improving making the solar more versatile compared to older models; i.e. printing, flexible, solar shingles, etc.
- Federal grants, tax incentives, and rebate programs are available to help with initial costs.

Disadvantages/Limitations:

- High initial costs for material and installation and long ROI.
- Needs lots of space as efficiency is not 100% yet.
- No solar power at night so there is a need for a large battery bank.
- Devices that run on DC power directly are more expensive.
- Depending on geographical location the size of the solar panels vary for the same power generation.
- Cloudy days do not produce much energy.
- Solar panels are not being massed produced due to lack of material and technology to lower the cost enough to be more affordable.
- Solar powered cars do not have the same speeds and power as typical gas powered cars.
- Lower production in the winter months.

(b) Wind Energy:

Advantages:

The main advantages include an unlimited, free, renewable resource (the wind itself), economic value, maintenance cost, and placement of wind harvesting facilities. First and foremost, wind is an unlimited, free, renewable resource. Wind is a natural occurrence and harvesting the kinetic energy of wind doesn't affect currents or wind cycles in any way. Next, harvesting wind power is a clean, non-polluting way to generate electricity. Unlike other types of power plants, it emits no air pollutants or greenhouse gases. The wind turbines harmlessly generate electricity from wind passing by. Wind energy is far more eco-friendly than the burning of fossil fuels for electricity. Strains on supply (of fossil fuels) are likely to

increase the prices of fossil fuel resources and leave the US economy exposed to international market volatility. Wind power has the ability to free the US from the figurative economic bondage of fossil fuels. Once turbines and energy centers have been installed, the cost of maintaining turbines and generating wind power is next to nothing. Another advantage of wind power is the ability to place turbines wherever necessary. Offshore winds tend to blow harder and more uniformly than on land, providing the potential for increased electricity generation and smoother, steadier operation than land-based wind power systems.

Disadvantages/Limitations:

The two major disadvantages of wind power include initial cost and technology immaturity. Firstly, constructing turbines and wind facilities is extremely expensive. The second disadvantage is technology immaturity. High cost of energy can, in part, be addressed directly with technology innovations that increase reliability and energy output and lower system capital expenses. Offshore wind energy produces more energy than onshore wind energy, but costs much more to establish. The primary costs of wind turbines include construction and maintenance. New technology is needed to lower costs, increase reliability and energy production, solve regional deployment issues, expand the resource area, develop infrastructure and manufacturing facilities, and mitigate known environmental impacts. Therefore, one may argue that implementation of wind energy must be delayed until technological advancements are made. Other disadvantages include:

- Aesthetic impact- Many people are concerned with the visual effects that wind turbines have on the beautiful scenery of nature.
- Wildlife- Wind turbines may be dangerous to flying animals. Many birds and bats have been killed by flying into the rotors.
- Remoteness of location- Although this may be an advantage (placing wind turbines in desolate areas, far away from people), it may also be a disadvantage. The cost of travel and maintenance on the turbines increases and is time consuming. Offshore wind turbines require boats and can be dangerous to manage.
- Noise- Some wind turbines tend to generate a lot of noise which can be unpleasant
- Safety at Sea- In the darkness/at night it may be difficult for incoming boats to see wind turbines thus leading to collisions.

(c) Biomass:

Advantages:

- Biomass is always and widely available as a renewable source of energy.
- It is carbon neutral- “As a natural part of photosynthesis, biomass fuels only release the same amount of carbon into the atmosphere as was absorbed by plants in the course of their life cycle”.
- It reduces the overreliance of fossil fuels.
- Less expensive than fossil fuels.
- Biomass production adds a revenue source for manufacturers.
- Less garbage in landfills.

Disadvantages/Limitations:

- Biomass energy is not as efficient as fossil fuels.
- It is not entirely clean.
- Can lead to deforestation- Since wood is one of the most used source of biomass energy, vast amounts of wood and other waste products have to be burned to produce the desired amount of power. While currently there is enough wood waste already, there is a risk of deforestation in the future.
- Biomass plants require a lot of space.

Fluoride Problem in Drinking Water

Fluoride Problem

Sources of fluoride:-

- (1) Drinking water having fluoride contain greater than 1.0 mg/l of water.
 - (2) Black tea.
 - (3) Black and red rock salt
 - (4) Snacks prepared from black and red rock salt.
 - (5) Dental products like fluoride containing toothpaste and mouth rinses.
 - (6) Drug containing fluoride on long time treatment for diseases such as depression, osteoporosis; etc.
 - (7) Tobacco or Supari chewing
- Excess of Fluoride Consumption:-

Figure 1

Excess of fluoride consumption in body results in fluorosis

"Symptoms of Fluorosis" :- / effects

- (1) stiffness in joints
- (2) Aches & pain in joints
- (3) Gastrointestinal problems
- (4) Muscle weakness
- (5) Anemia / low haemoglobin
- (6) Infertility

~~Water borne diseases~~ →

Mineral Resources → Minerals can be classified on the basis of their industrial use, as following :-

- (1) Metallic minerals → (ferrous group)
eg. iron (Fe), Mn, Ni
- (2) Metallic minerals (non-ferrous group)
eg. Cu, Al
- (3) Fertilizer minerals → eg. Gypsum, rock phosphate
- (4) Mineral fuels → eg. Coal; Petroleum;

Figure 2

Imp. minerals and their location :-

- (1) Coal → It belongs to 2 geographical areas.
 - (a) Lower Godwana Coals → found in West Bengal, Jharkhand and Andhra Pradesh etc.
 - (b) Tertiary Coals → found in Assam, Meghalaya, Rajasthan etc.
- (2) Bauxite → Jharkhand, Chhattisgarh, Jammu & Kashmir, Gujarat etc.
- (3) Asbestos → Jharkhand, Karnataka, Rajasthan etc.
- (4) Cobalt → Rajasthan & Kerala.
- (5) Copper → Jharkhand, Rajasthan, Uttarakhand.
- (6) Gold → Karnataka, Andhra Pradesh, Tamil Nadu.
- (7) Graphite → Andhra Pradesh, Orissa, Jharkhand.
- (8) Petroleum → Assam, Gujarat, Maharashtra.
- (9) Natural gas → Assam & Gujarat.
- (10) Silver → Karnataka, Bihar & Rajasthan.
- (11) Thorium → Kerala.
- (12) Uranium → Jharkhand.

Figure 3

Mining investment policies

- (1) For exploration & mining of diamonds and other precious stones, FDI (Foreign Direct Investment) upto 74% is permitted.
- (2) For exploration & mining of gold & silver & other minerals, FDI upto 100 is allowed.
- (3) Private Indian companies engaged in power projects as well as coal and lignite mines are allowed to 100% FDI.
- (4) For metallurgy & processing FDI upto 100% is permitted.

Investment incentives :-

- (1) Mining in a specified backward area is eligible for a complete tax holiday for a period of five years from the commencement of production.
- (2) Environment protection equipment, pollution control equipments are eligible for 100% depreciation.
- (3) Minerals in their finished forms are exempted from excise duty.

Health & safety in mines :- The death rate per thousand person in mines was around 0.32 in 1990's, which has come down to a lower value in the present generation.

It is due to the awareness regarding safety & hazards that has been

Figure 4

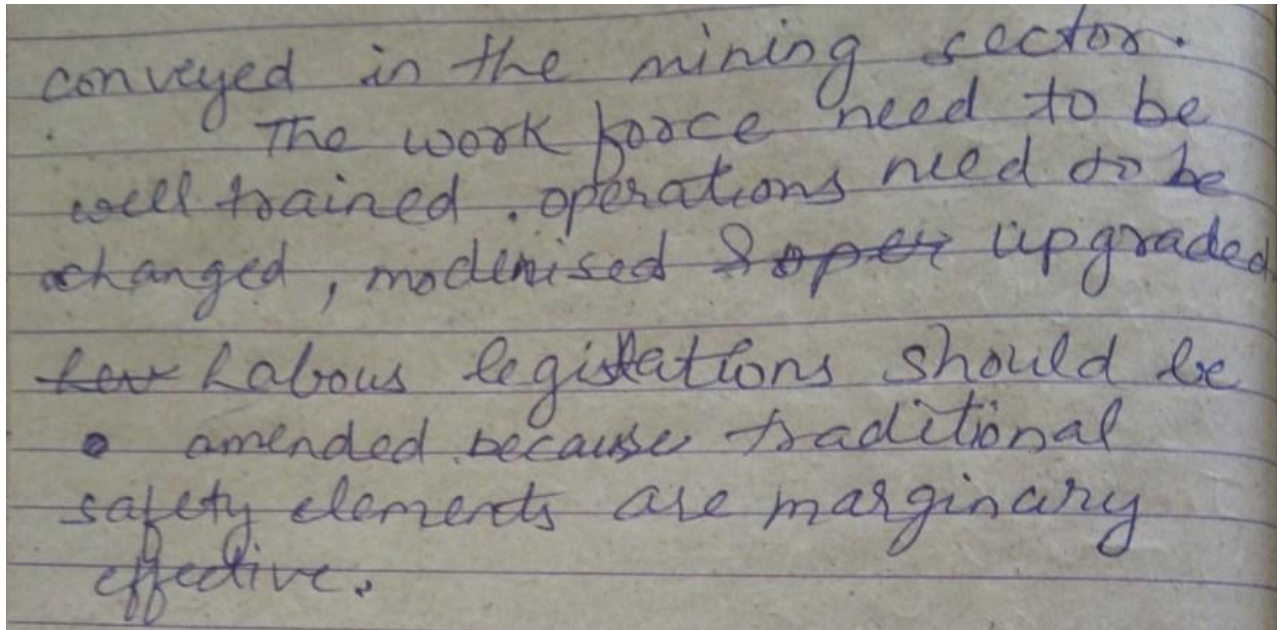


Figure 5

Hydrogen as An Alternative Energy Source

Hydrogen is abundant in our environment. It's stored in water (H_2O), hydrocarbons (such as methane, CH_4), and other organic matter. One of the challenges of using hydrogen as a fuel comes from being able to efficiently extract it from these compounds.

Currently, steam reforming, combining high-temperature steam with natural gas to extract hydrogen, accounts for the majority of the hydrogen produced in the United States. Hydrogen can also be produced from water through electrolysis. This is more energy intensive but can take advantage of inexpensive excess renewable energy, such as wind or solar, while avoiding the harmful emissions associated with other kinds of energy production. Although the production of hydrogen may generate emissions affecting air quality, depending on the source, an FCEV (Fuel cell electric Vehicles) running on hydrogen emits only water vapor and warm air as exhaust and is considered a zero-emission vehicle.

Hydrogen is considered an alternative fuel under the Energy Policy Act of 1992. The interest in hydrogen as an alternative transportation fuel stems from its ability to power fuel cells in zero-emission FCEVs, its potential for domestic production, its fast filling time, and the fuel cell's high efficiency. In fact, a fuel cell coupled with an electric motor is two to three times more efficient than an internal combustion engine running on gasoline. Hydrogen can also serve as fuel for internal combustion engines. However, unlike FCEVs, these produce tailpipe emissions and are less efficient.

UNIT III

Air Pollution

Air Pollution is basically the presence of foreign substances in air in excessive concentration which adversely affects the well being of individuals or causes damage to property.

Causes/Sources of Air Pollution

1. Urbanization
2. Industrialization
3. Motorization
4. Energy production from thermal plants.
5. Burning of Domestic fuel.
6. Burning of Agricultural wastes.

Effects of Air Pollution

1. Respiratory and heart problems.
2. Global warming.
3. Acid Rain: Acid rain results when sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are emitted into the atmosphere and transported by wind and air currents. The SO_2 and NO_x react with water, oxygen and other chemicals to form sulfuric and nitric acids ultimately having pH of about 4.7 or less.
4. Eutrophication: Eutrophication is a condition where high amount of nitrogen present in some pollutants gets developed on sea's surface and turns itself into algae and adversely affect fish, plants and animal species. The green colored algae that is present on lakes and ponds is due to presence of this chemical only.
5. Effect on Wildlife.
6. Depletion of Ozone Layer.
7. Green House Effect: The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

Green House Gases: Gas molecules that absorb thermal infrared radiation, and are in significant enough quantity, can force the climate system. These type of gas molecules are called greenhouse gases (CO_2 , CH_4 , N_2O , SF_6 , NF_3 , Hydro

fluorocarbons, per fluorocarbons)

Methods of controlling/Minimizing Air Pollution

1. Zoning (marking areas for a specific industry type)
2. Control at source (for example, use of less Sulfur containing fuel in varied industries)
3. Control by different devices:
 - a) Internal Separators- Gravity settling chambers; cyclone collector & Fabric filters.
 - b) Wet Collection Devices- Cyclonic scrubber, Venturi scrubber, packed-bed scrubbers.
 - c) Electrostatic Precipitators.

Soil/Land Pollution

Land pollution means degradation or destruction of earth's surface and soil, directly or indirectly as a result of human activities.

Causes/Sources of Soil Pollution

1. Agricultural Practices: Involves use of such Pesticides, Insecticides, Herbicides or fertilizers that can destroy soil fertility.
2. Radioactive Materials.
3. Biological Agents: Arising from household refuse, industrial water/wastes; agricultural wastes.
4. Deforestation & soil erosion.
5. Mining activities: During extraction and mining activities, several land spaces are created beneath the surface. We constant hear about land caving in; this is nothing but nature's way of filling the spaces left out after mining or extraction activity.
6. Construction activities.
7. Sewage treatment: Large amount of solid waste is leftover once the sewage has been treated. The leftover material is sent to landfill site which end up in polluting the environment.

Effects of Soil Pollution

1. Change in climate patterns: The effects of land pollution are very hazardous and can lead to the loss of ecosystems. When land is polluted, it directly or indirectly affects the climate patterns.
2. Environmental Impact: When deforestation is committed, the tree cover is compromised on. This leads to a steep imbalance in the rain cycle. A disturbed rain cycle affects a lot of factors. To begin with, the green cover is reduced. Trees and plants help balance the atmosphere, without them we are subjected to various concerns like Global warming, the green house effect, irregular rainfall and flash floods among other imbalances.
3. Effect on Human health: The land when contaminated with toxic chemicals and pesticides lead to problem of skin cancer and human respiratory system. The toxic chemicals can reach our body through foods and vegetables that we eat as they are grown in polluted soil.
4. Causes Air Pollution: Landfills across the city keep on growing due to increase in waste and are later burned which leads to air pollution. They become home for rodents, mice etc which in turn transmit diseases.
5. Distraction for Tourists: The city loses its attraction as tourist destination as landfills do not look good when you move around the city. It leads to loss of revenue for the state government.
6. Effect on Wildlife.

Methods of controlling/Minimizing Soil Pollution

1. Make people aware about the concept of Reduce, Recycle and Reuse.
2. Reduce the use of pesticides and fertilizers in agricultural activities.
3. Avoid buying packages items as they will lead to garbage and end up in landfill site.
4. Ensure that we do not litter on the ground and do proper disposal of garbage.
5. Buy biodegradable products.
6. Do Organic gardening and eat organic food that will be grown without the use of pesticides.
7. Create dumping ground away from residential areas.

Water Pollution

Addition of any substance to water or changing of water's physical, chemical or biological characteristics in any way which interferes with its use for legitimate purpose.

Types of Water pollution

1. Physical pollution: Caused mainly due to organic materials getting into water. Organic materials are decomposed by using large quantity of oxygen from water.
2. Biological pollution: Occurs when living things are added to water. Rishikesh, Haridwar have problems of this type of pollution.
3. Chemical Pollution: Major source are discharge of waste water & discharge of industrial effluents in urban areas of land.
4. Radioactive pollution: Presence of radioactive materials in drinking water is rare since unique care & attention is taken to dispose radioactive waste.
5. Marine Pollution: Marine ecosystems also lack decomposing capacity. Main source of oceanic pollution are navigational discharges of oil, grease & petroleum products, sewage & garbage detergents.

Water Pollution Control

1. Sewage treatments: The household water should be treated properly so that they become environmentally safe.
2. Prevent river water to get polluted: People should not be allowed to throw wastes into the river water.
3. Treatment of wastes before discharge: Factories are expected to treat its effluent wastes prior to discharge. Toxic material must be treated chemically and converted into harmless materials. If possible, factories should try to recycle the treated water.
4. Treatment of drainage water: The water that flows through the city drainage system should be properly treated. Harmful pollutants should be removed, before they are introduced into reservoirs.
5. Keep the pond water clean and safe: Washing, bathing of cattle in the pond that is used by human should not be done.

6. Routine cleaning: A system of regular testing of pond and lake water can be introduced to ensure the safety of the water.
7. Don't pour insecticides in sinks and toilets.
8. Public Awareness.
9. Removal of Hg & NH₃: Can be done by using selective ion exchange resin.

Noise Pollution

Noise Pollution

Noise is any sound independent of loudness, which can produce an undesired physiological or psychological effect in an individual.

Noise Classification :-

- (i) Automobile noise (transport noise) →
- (i) Road traffic noise → Due to the increased speed of vehicles, noise pollution has also increased. Modern highways and traffic system has encouraged higher speeds.
- (ii) Air craft noise → There are peak noise levels when aircraft fly overhead or takeoff and land at airports. The peak frequency varies with no. and type of aircraft as well as operational height.
- (iii) Rail traffic noise → It is generally of lower frequency compared to

street vehicles. However buildings located besides railway tracks are more exposed to this ^{kind of} noise.

1) Occupational noise → It is mainly produced by industrial machines, domestic / household gadgets such as machines etc. for ex- Textile loom, farm tractor, newspaper press, high speed drill, supermarket etc.

2) Neighbourhood Noise → It implies to a variety of noise which annoy the general public by while interfering with their comfort. Ex- loud TV noise, Radio, Caset player, disco music, loudspeaker etc. Other than these — door slamming, domestic generator, pressure cooker, air

conditional etc.

Harmful Effects of Noise Pollution:

- (1) It can effect human health, comfort and efficiency.
- (2) It causes high blood pressure, contraction of blood vessels.
- (3) Noise pollution changes hormone content of blood, increases heart beat and dilation of pupil of eye.
- (4) Main harmful effect of noise pollution is the impairment of hearing loud sound can damage ear drum.
- (5) Noise pollution causes frustration, physical and mental fatigue. Low frequency noise causes distraction in normal sleep pattern.
- (6) It also produces emotional disturbances, ~~not~~ behaviour change.
- (7) Ultrasonic sound can affect the digestive, respiratory, cardiovascular

-lar system and semicircular canals of the internal ear.

Control of Noise Pollution :-

On the basis of different type of sources, noise pollution can be controlled in different manners.

Industrial noise control → It can be controlled by replacing noise producing machinery.

Interrupting the path of the sound by using insulating material.

It can also be reduced by application of engineer control techniques. Noisy operations

should be conducted in an open space. Trees, plants are good absorbers of sound therefore they should be planted near highways and industrial areas.

Community Noise Control → To

Control aircraft noise flight path are far away from populated areas whenever necessary. Another method to control aircraft noise is to set the limit of aircraft engine noise. Roadway traffic can be controlled by using a number of alternative techniques-

- 1) The source can be controlled by making quite vehicles.
- 2) Highways should be routed away from populated areas.
- 3) Lowering the speed limit and desiring for non-stop operation also reduces the noise pollution.

Automobile Pollution

Automobile Pollution

Automobiles are a necessary evil which have made life easy and convenient, also they have made human life more complicated and vulnerable to both toxic emissions and an increased risk of accidents.

Sources of automobile pollutants:

- (1) Hydrocarbons → Hydrocarbons are toxins and are major contributors to smog which can be ~~me~~ a major problem in urban areas.
- (2) Carbon Monoxide → It is a product

of incomplete combustion, it reduces blood's ability to carry oxygen.

(3) Nitrogen oxides (NO_x) \rightarrow It is generated when nitrogen in air reacts with oxygen at high temperature and pressure inside the engine.

(4) Particulate matter \rightarrow ~~Food~~ or Soot or smoke made up of particles in micrometer size range. (10^{-6})

(5) Sulphur oxide \rightarrow These are emitted from vehicles, burning fuel containing a high concⁿ of sulphur.

Effects of Automobile pollutants:-

(1) Long exposure to hydrocarbons contributes to asthma, liver diseases, cancer etc. Over exposure of carbon monoxide

- may result in fatal death.
- (2) Nitrogen oxide is a precursor to smog and acid rain. It destroys resistance to respiratory infection.
 - (3) Particulate matter causes negative health effects including but not limited to respiratory diseases.
 - (4) Oil, petroleum products and other toxins from automobiles kill fish, plants, aquatic life. These toxins as well as trace metals and degreasing agents used on automobile contaminate drinking water and can cause major illness.
 - (5) Phosphorus and nitrogen causes explosive growth of algae which depletes oxygen level, kills fish and aquatic life.

Minimization / Control of Automobile pollution :-

- (1) Reduce use of automobiles and use car pool.
- (2) Monitor and repair automobile leakages regularly.
- (3) Always take used oil, and batteries and other fluids to a repair shop for proper disposal.
- (4) Take your car to a commercial car wash or use detergents that do not contain phosphorus to wash your car.
- (5) Never allow oil or other toxins to run off into the ground.
- (6) When purchasing a new automobile always look for cars or bikes with high fuel efficiency rating.

UNIT IV

Climate Change, Global Warming & Green House Gases

Climate change refers to significant, long-term changes in the global climate. The global climate is the connected system of sun, earth and oceans, wind, rain and snow, forests, deserts and savannas, and everything people do, too. The climate of a place can be described as its rainfall, changing temperatures during the year and so on.

Global warming is the slow increase in the average temperature of the earth's atmosphere because an increased amount of the energy (heat) striking the earth from the sun is being trapped in the atmosphere and not radiated out into space.

Global Warming driving Climate Change

Heat is energy and when you add energy to any system changes occur. Because all systems in the global climate system are connected, adding heat energy causes the global climate as a whole to change. Much of the world is covered with ocean which heats up. When the ocean heats up, more water evaporates into clouds. Where storms like hurricanes and typhoons are forming, the result is more energy-intensive storms. A warmer atmosphere makes glaciers and mountain snow packs, the Polar ice cap, and the great ice shield jutting off of Antarctica melt raising sea levels.

Global Warming- Causes

Global warming and climate change result from human activity (are “anthropogenic”), scientists attribute current atmospheric warming to human activities that have increased the amount of carbon containing gases in the upper atmosphere and to increased amounts of tiny particles in the lower atmosphere. Specifically, gases released primarily by the burning of fossil fuels and the tiny particles produced by incomplete burning trap the sun's energy in the atmosphere. These gases are termed as “greenhouse gases” (GHGs) because they act like the wrong way reflective glass in our global greenhouse.

The tiny particles termed are termed as ‘black carbon’ (soot or smoke) and attribute their warming effect to the fact that the resulting layer of black particles in the lower atmosphere absorbs heat like a black blanket.

The global warming trend has accelerated as we have increased our use of fossil fuels to include gasoline, diesel, kerosene and natural gas, as well as the petrochemicals (plastics, pharmaceuticals, fertilizers) we now make from oil.

Greenhouse gases (GHGs)

The most common and most talked about greenhouse gas is CO₂ or carbon dioxide. Methane, another important GHG, is 28-36 times as warming as CO₂. The most commonly discussed GHGs are:

- CO₂ or carbon dioxide is produced any time something is burned. Carbon dioxide is assigned a GWP or Global Warming Potential of 1.
- Methane or CH₄ is produced in many combustion processes and also by anaerobic decomposition, for example, in flooded rice paddies, pig and cow stomachs, and pig manure ponds. It has a GWP of 28-36.
- Nitrous oxide in perian (laughing gas), NO/N₂O or simply NO_x is a byproduct of fertilizer production and use, other industrial processes and the combustion of certain materials
- Fluorinated gases were created as replacements for ozone depleting refrigerants, but have proved to be both extremely long lasting and extremely warming GHGs. Their GWPs range from 1,800 to 8,000 and some variants top 10,000.
- Sulphur hexafluoride or SF₆ is used for specialized medical procedures, but primarily in what are called dielectric materials, especially dielectric liquids. SF₆ will last thousands of years in the upper atmosphere and has a GWP of 22,800.

Climate change & Global Warming Impact

- Because the global climate is a connected system climate change impacts are felt everywhere. Among the most important climate change impacts are:
- Rising Sea Levels: Climate change impacts rising sea levels. Average sea level around the world rose about 8 inches (20 cm) in the past 100 years. Coastal cities such as New York are already seeing an increased number of flooding events and by 2050 many such cities may require seawalls to survive.
- Melting Ice: Projections suggest climate change impacts within the next 100 years, if not sooner, the world's glaciers will have disappeared, as will the Polar ice cap, and the huge Antarctic ice shelf, Greenland may be green again, and snow will have become a rare phenomenon at what are now the world's most popular ski resorts.
- Torrential downpours and more powerful storms: While the specific conditions that produce rainfall will not change, climate change impacts the amount of water in the atmosphere and will increase producing violent downpours instead of steady showers when it does rain.

- Hurricanes and typhoons: They will increase in power, and flooding will become more common.
- Heatwaves and droughts: Despite downpours in some places, droughts and prolonged heatwaves will become common.
- Changing ecosystems: As the world warms, entire ecosystems will move. Already rising temperatures at the equator have pushed such staple crops as rice north into once cooler areas, many fish species have migrated long distances to stay in waters that are the proper temperature for them.
- Reduced food security: One of the most striking impacts of rising temperatures is felt in global agriculture. Different crops grow best at quite specific temperatures and when those temperatures change, their productivity changes significantly. The productivity of rice, the staple food of more than one third of the world's population, declines 10% with every 1° C increase in temperature.
- Pests and Disease: Rising temperatures favor agricultural pests, diseases and disease vectors. Pest populations are on the rise and illnesses once found only in limited, tropical areas are now becoming endemic in much wider zones.

Urbanization

Urbanisation results from a natural increase in the population and rural to urban migration. People migrate to towns and cities in hope of gaining a better standard of living. The promise of jobs and prosperity, among other factors, pulls people to cities. Urbanisation has negative consequences on health due mainly to pollution and overcrowded living conditions. Poor air and water quality, insufficient water availability, waste-disposal problems, and high energy consumption are exacerbated by the increasing population density and demands of urban environments. Strong city planning will be essential in managing these and other difficulties as the world's urban areas swell.

Threats & Effects

- Intensive urban growth can lead to greater poverty, with local governments unable to provide services for all people.
- Concentrated energy use leads to greater air pollution with significant impact on human health.
- Automobile exhaust produces elevated lead levels in urban air.
- Large volumes of uncollected waste create multiple health hazards.
- Urban development can magnify the risk of environmental hazards such as flash flooding.
- Pollution and physical barriers to root growth promote loss of urban tree cover.

- Animal populations are inhibited by toxic substances, vehicles, and the loss of habitat and food sources.

Control Measures

- Combat poverty by promoting economic development and job creation.
- Involve local community in local government.
- Reduce air pollution by upgrading energy use and alternative transport systems.
- Create private-public partnerships to provide services such as waste disposal and housing.
- Plant trees and incorporate the care of city green spaces as a key element in urban planning.

Ozone Layer Depletion

Ozone depletion, gradual thinning of Earth's ozone layer in the upper atmosphere caused by the release of chemical compounds containing gaseous chlorine or bromine from industry and other human activities. The thinning is most pronounced in the Polar Regions, especially over Antarctica. Primary cause of ozone depletion is the presence of chlorine-containing source gases (primarily CFCs and related halocarbons). In the presence of UV light, these gases dissociate, releasing chlorine atoms, which then go on to catalyze ozone destruction. The Cl-catalyzed ozone depletion can take place in the gas phase, but it is dramatically enhanced in the presence of polar stratospheric clouds (PSCs).

Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage.

The Montreal Protocol, ratified in 1987, was the first of several comprehensive international agreements enacted to halt the production and use of ozone-depleting chemicals. As a result of continued international cooperation on this issue, the ozone layer is expected to recover over time.

Photochemical Smog

Smog is a type of intense air pollution. This kind of visible air pollution is composed of nitrogen oxides, sulphur oxides, ozone, smoke and other particulates. Man-made smog is derived from coal combustion emissions, vehicular emissions, industrial emissions, forest and agricultural fires and photochemical reactions of these emissions.

Photochemical smog, often referred to as summer smog, is the chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in the atmosphere, which

leaves airborne particles and ground-level ozone. Photochemical smog depends on primary pollutants as well as the formation of secondary pollutants. These primary pollutants include nitrogen oxides, particularly nitric oxide (NO) and nitrogen dioxide (NO₂), and volatile organic compounds. The relevant secondary pollutants include peroxyacyl nitrates (PAN), tropospheric ozone, and aldehydes. An important secondary pollutant for photochemical smog is ozone, which is formed when hydrocarbons (HC) and nitrogen oxides (NO_x) combine in the presence of sunlight; nitrogen dioxide (NO₂), which is formed as nitric oxide (NO) combines with oxygen (O₂) in the air.

Effects

Photochemical smog has many adverse effects.

- When combined with hydrocarbons, the chemicals contained within it form molecules that cause eye irritation.
- Other effects include reduced visibility and respiratory ailments.
- Ground level ozone is also produced which has various effects on the human body. Ground-level ozone, sulphur dioxide, nitrogen dioxide and carbon monoxide are especially harmful for senior citizens, children, and people with heart and lung conditions such as emphysema, bronchitis, and asthma.
- It can inflame breathing passages, decrease the lungs' working capacity, causes shortness of breath, pain when inhaling deeply, wheezing, and coughing.
- It dries out the protective membranes of the nose and throat and interferes with the body's ability to fight infection, increasing susceptibility to illness.

Population Growth

Overpopulation is an undesirable condition where the number of existing human population exceeds the carrying capacity of Earth.

Causes of Overpopulation

- Decline in the Death Rate
- Better Medical Facilities
- More Hands to Overcome Poverty: For thousands of years, a very small part of the population had enough money to live in comfort. The rest faced poverty and would give birth to large families to make up for the high infant mortality rate. Families that have been through poverty, natural disasters or are simply in need of more hands to work are a major factor for overpopulation. As compared to earlier times, most of these extra children survive and consume resources that are not sufficient in nature.

- Technological Advancement in Fertility Treatment
- Immigration
- Lack of Family Planning

Effects of Overpopulation

- Depletion of Natural Resources
- Degradation of Environment
- Conflicts and Wars
- Rise in Unemployment
- High Cost of Living

Solutions to Overpopulation

- Better Education
- Making People Aware of Family Planning
- *Tax Benefits or Concessions:* Government of various countries might have to come with various policies related to tax exemptions to curb overpopulation. One of them might be to waive of certain part of income tax or lowering rates of income tax for those married couples who have single or two children. As we humans are more inclined towards money, this may produce some positive results.
- *Knowledge of Sex Education:* Imparting sex education to young kids at elementary level should be must.

Flood

A flood occurs when water overflows or inundates land that's normally dry.

Causes/Sources of Floods

1. Rivers or streams overflow their banks.
2. Excessive rain
3. A ruptured dam
4. Rapid ice melting in the mountains.
5. Unfortunately placed beaver dam can overwhelm a river and send it spreading over the adjacent land, called a floodplain.
6. Coastal flooding occurs when a large storm or tsunami causes the sea to surge inland.

Types of Floods

1. General/Normal Floods: These take hours or even days to develop, giving residents ample time to prepare or evacuate.

2. Flash Floods: These generate quickly and with little warning. These flash floods can be extremely dangerous.

Effects of Floods

Moving water has awesome destructive power. When a river overflows its banks or the sea drives inland, structures poorly equipped to withstand the water's strength are no match. Bridges, houses, trees, and cars can be picked up and carried off. The erosive force of moving water can drag dirt from under a building's foundation, causing it to crack and tumble.

When floodwaters recede, affected areas are often blanketed in silt and mud. The water and landscape can be contaminated with hazardous materials, such as sharp debris, pesticides, fuel, and untreated sewage. Potentially dangerous mold blooms can quickly overwhelm water-soaked structures. Residents of flooded areas can be left without power and clean drinking water, leading to outbreaks of deadly waterborne diseases like typhoid, hepatitis A, and cholera.

Earthquakes

They are the vibrations caused by rocks breaking under stress. The underground surface along which rock breaks & moves is called a Fault Plane. A seismograph, or seismometer, is an instrument used to detect and record earthquakes.

Magnitude of earthquake is a measure of energy released by the earthquake. A magnitude 6.0 earthquake releases approx. 30 times more energy than a magnitude 5.0 earthquake.

Location where earthquake starts is Hypocenter & location directly above it on surface of earth is termed as Epicenter.

Foreshock: Smaller earthquakes that happen in the same place as the larger earthquake that follows. The largest, main earthquake is called as Mainshock.

Aftershocks: Smaller earthquakes that occur afterwards in the same place as the mainshock.

Rise of an earthquake/Causes of an earthquake

The earth has four major layers: the inner core, outer core, mantle and crust. The crust and the top of the mantle make up a thin skin on the surface of our planet. But this skin is not all in one piece – it is made up of many pieces like a puzzle covering the surface of the earth. These puzzle pieces keep slowly moving around, sliding past one another and bumping into each other. We call these puzzle pieces tectonic plates, and the edges of the plates are called the plate boundaries.

The plate boundaries are made up of many faults, and most of the earthquakes around the world occur on these faults. Since the edges of the plates are rough, they get stuck while the rest of the plate keeps moving. Finally, when the plate has moved far enough, the edges unstick on one of the faults and there is an earthquake.

Cyclones

Cyclone refers to any spinning storm that rotates around a low-pressure center. The low-pressure center is also referred to as the 'eye' of the storm. If the storm occurs in the Atlantic Ocean and Northeast Pacific, it's called a hurricane. If the exact same type of storm occurs in the Northwest Pacific, this is a typhoon.

Types of Cyclones

1. Tropical cyclones: Hurricanes and typhoons are actually types of tropical cyclones, but they have different names so that it's clear where that storm is occurring. Hurricanes are found in the Atlantic and Northeast Pacific, typhoons are found in the Northwest Pacific. If we talk about 'tropical cyclone'; then we should assume that it's occurring in the South Pacific or Indian Ocean, but we'll use this term to all types of tropical ocean cyclones.
2. Polar cyclones: Cyclones that occur in polar regions like Greenland, Siberia and Antarctica. Unlike tropical cyclones, polar cyclones are usually stronger in winter months.
3. Mesocyclone: When part of a thunderstorm cloud starts to spin, which may eventually lead to a tornado. 'Meso' means 'middle'. Tornadoes all come from thunderstorm clouds, but not all thunderstorm clouds make tornadoes. In order for a tornado to occur, part of that cloud has to spin, and though you can't really see this happening, this is the intermediate, or 'meso' step from regular cloud to dangerous spinning cloud running along the ground.

Causes of a Cyclone

Cyclones are primarily caused by high ocean temperatures, broad-scale wind systems and clustered thunderstorms, which liberate the heat energy from the ocean surface and transfer it to the cyclone. This heat from the ocean combines with the Earth's rotation to create the cyclone's spin and propulsion. As the cyclone moves across cooler waters, land or into unfavorable wind systems, it gradually begins to dissipate as it loses energy.

There are a number of additional atmospheric conditions that must be present in order for a cyclone to form, including moisture layers in the mid-troposphere, approximately 3 miles above the Earth's surface, and low vertical wind shear

between the Earth's surface and the upper troposphere. Cyclones also need to be at least 310 miles from the equator, where the deflective Coriolis force of the planet's rotation begins to take effect.

Landslides

A landslide is the movement of rock, debris or earth down a slope. They result from the failure of the materials which make up the hill slope and are driven by the force of gravity. Landslides are known also as landslips, slumps or slope failure. They can come from natural causes or from the activities of people. The one thing they all have in common is gravity.

Causes of a Landslide

The cause of a landslide that has to do with the structural combination of rock, soil and vegetation is the morphology. If a hillside has lost vegetation because of a fire for instance, then the addition of water can cause erosion, upping the chances for a landslide. It's not only rain that can cause erosion but flowing rivers, moving glaciers, and crashing ocean waves. The geology or strength of the earth material itself can also be a factor in landslides. Stronger material is less likely to break apart and slide down the slope. And finally, there are human activities that can expose slopes to erosion and lead to landslides. Clearing land for agriculture or construction are some of the human causes of landslides.

Unit-5

Environmental Legislations :-

Forest and wildlife Protection Act:

1. It came into existence in 1972.
2. It extends to the whole of India except in the state of Jammu & Kashmir (till 2019).
3. It shall come into force in a union territory on such a date as the central government may by notification, appoint, and different dates may be appointed for different provisions of this act.

Some Definitions -

- (1) Animal - It includes Amphibians, birds, mammals and reptiles and their young ones and also includes their eggs.
- (2) Animal Article - It means an article made from any captive animal or wild animal other than vermin and includes

an article or object in which the whole or any part of such animal is used.

(3) Captive Animal - It means any animal specify ~~them~~ in schedule 1, schedule 2, schedule 3 which is kept or ~~he~~ captured or breed in captivity.

(4) Collector - It means the chief officer incharge ~~all~~ the revenue administration in a district.

Water Pollution Control Regulation/
water (Prevention & Control) of
Pollution ACT:-

(1) It came into existence in 1974.

(2) The main objectives of this ACT are (i) To provide for the prevention and control of water pollution

(ii) To maintain or restore the wholesomeness of water.

(iii) To establish water pollution control

board in different areas.

- (iv) To assign suitable powers and function for the water pollution control board.

Some definitions:-

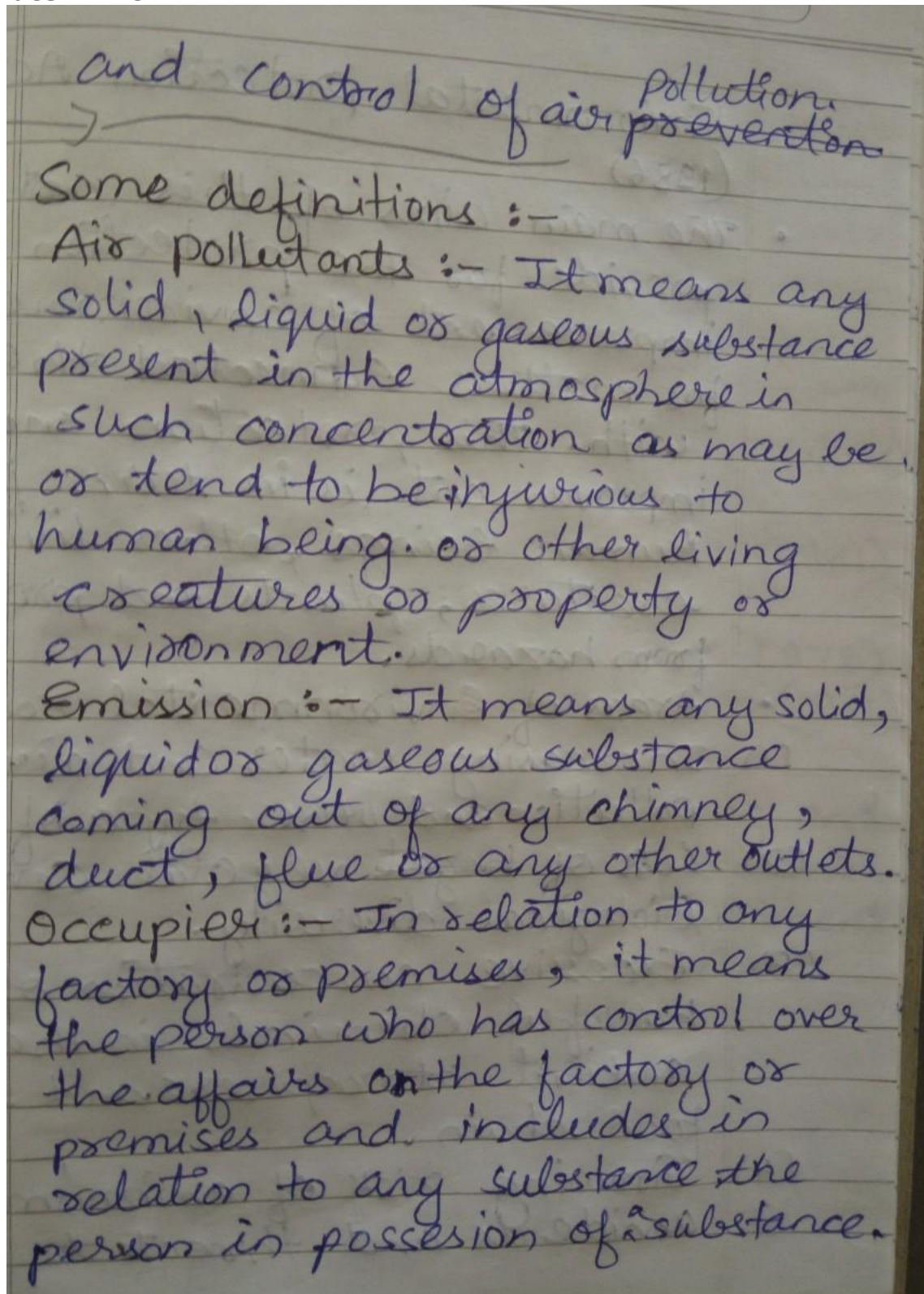
- (1) Sewage Effluent → It means any effluent from any ~~sewage~~ sewerage system or sewage disposal works and include ~~stullage~~ from open drain.
- (2) Trade Effluent → It includes any liquid, solid or gaseous substance which is discharged from any premises use for ~~carrying~~ or carrying on any other ~~dam~~ than domestic sewage.

Air (Prevention and Control ACT):
(1981)

Following are the main objectives

- (a) To provide for the prevention

All the objectives of "Water Act" & "Air Act" are exactly same, only replace the word "Water" with "Air".



Environmental protection ACT:- (1986)

- The main aims of this act is to provide for the protection and improvement of environment and for matters connected there with. This protection and improvement is in turn protects human beings, other living creatures, plants and property from hazards.
- Areas of Environmental concern:
 - (1) Increasing water and air pollution and other types of pollution
 - (2) Loss of ~~beget~~ vegetal cover and biological diversity.
 - (3) Excessive concentration of harmful chemicals in the ambient atmosphere and in food chain.
 - (4) Growing risk of environmental accidents and threats to life

support system.

Women Empowerment:-

Welfare program for women at the central -

- (1) The equal Remuneration act (1976)
- (2) Hindu Marriage Act (1955)
- (3) ~~The~~ Dowry prohibition ACT (1961)
- (4) The factories ACT (1948)
- (5) The child Marriage ACT (1978)
- (6) The Maternity benefit ACT (1961)

STEP - support to training and employment program for women

DWCRA - Development of women and child ~~in~~ in Rural Area.

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