

ENVIRONMENTAL SCIENCE (3110007)

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Sr.	Topics	Teaching Hours	Module Weightage
1	<p>INTRODUCTION TO ENVIRONMENT</p> <p>Definition, principles and scope of Environmental Science. Impacts of technology on Environment, Environmental Degradation, Importance for different engineering disciplines</p>	2	8 %

ENVIRONMENTAL POLLUTION

- a) **Water Pollution:** Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants
- b) **Air Pollution:** Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO₂, NO_X, Auto exhaust, Effects of common air pollutants
- c) **Noise Pollution:** Introduction, Sound and Noise, Noise measurements, Causes and Effects
- d) **Solid Waste:** Generation and management
- e) **Bio-medical Waste:** Generation and management
- f) **E-waste:** Generation and management

14

44 %

3

GLOBAL ENVIRONMENTAL ISSUES

Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change

6

24 %

4	<p>BASIC CONCEPT OF GREEN BUILDING AND SMART CITIES</p> <p>Green Building: Introduction, Objectives, Fundamental Principles, Benefits of Green Building, Examples of Green Building Smart Cities: Concept</p>	4	16 %
5	<p>CONCEPT OF 4R's</p> <p>Principles, Application of 4R's</p>	2	8%

Chapter-1

Introduction to Environment

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Environment

- External **Surroundings** and condition which is directly or indirectly affects the living organisms.

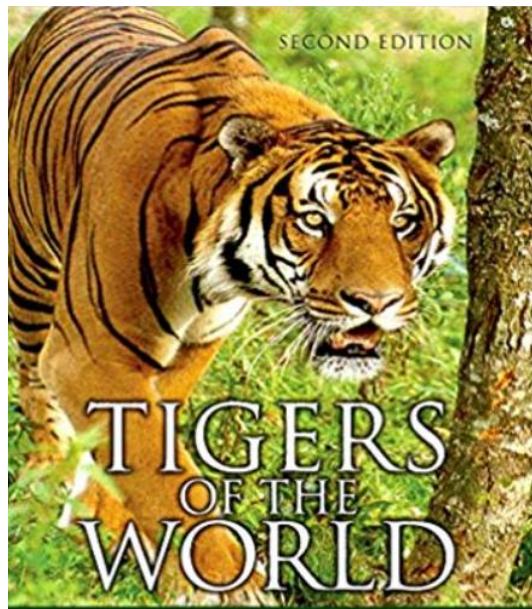
OR

- Environment is sum total of **water, air and land**, interrelationship among themselves and also with the human beings, other living organisms and property.



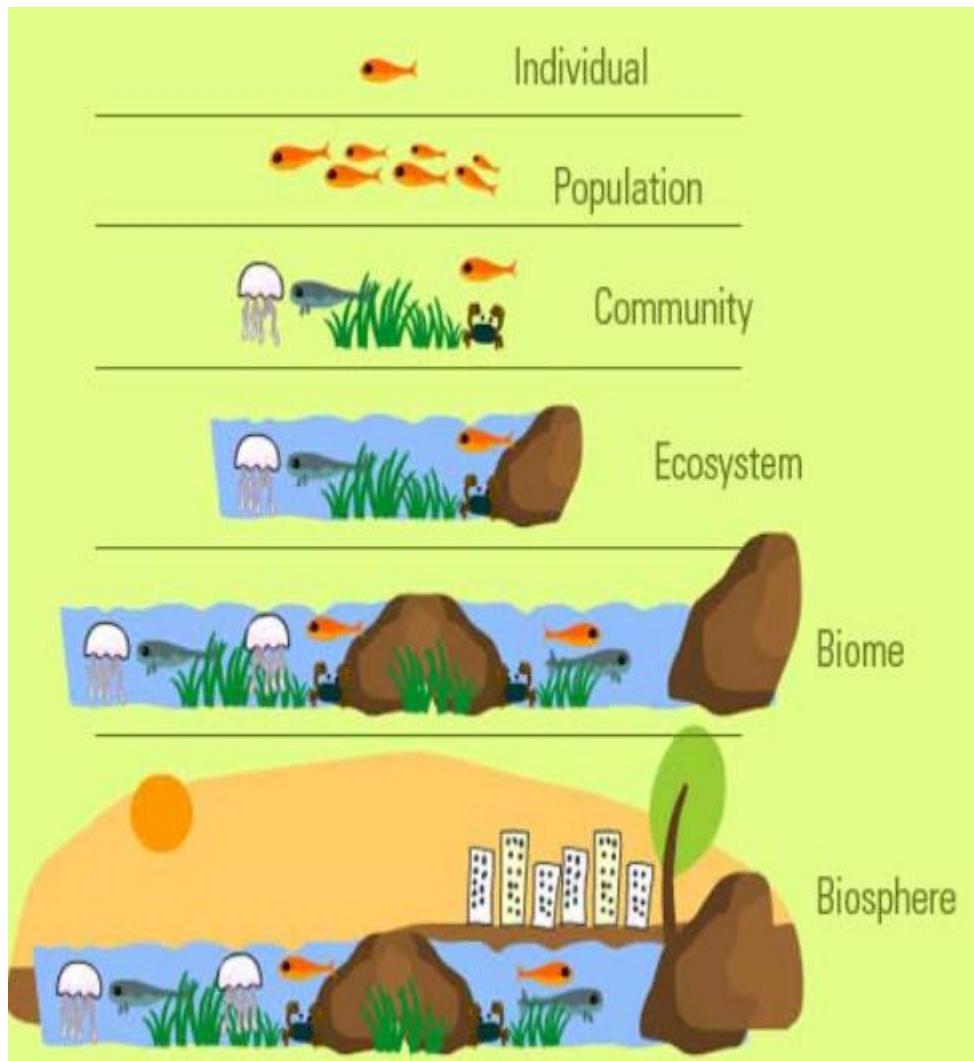
Ecology

- The word Ecology is derived from two Greek words “**oikos**” meaning house, habitation or place of living and “**logas**” meaning study.
- Ecology is the study of the **interrelationship** between living organisms and their physical and biological **ENVIRONMENT**.



Ecosystem:

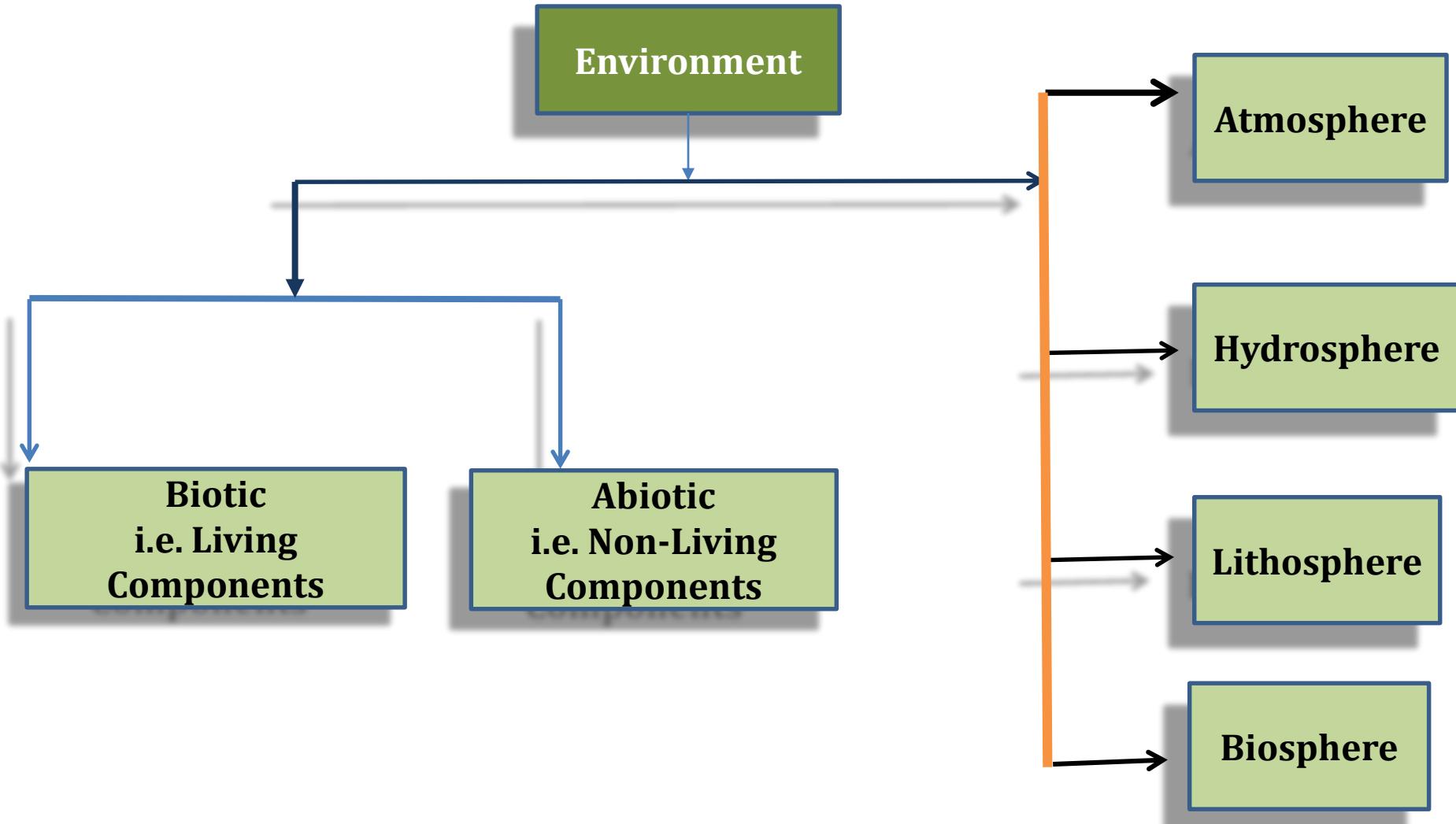
- Ecosystem is made up of two words “**eco**” and “**system**” eco means environment and system means and interacting and interdependent complex.
- Food chain, Food Web, Biogeochemical Cycles.



Scope of Environment Science

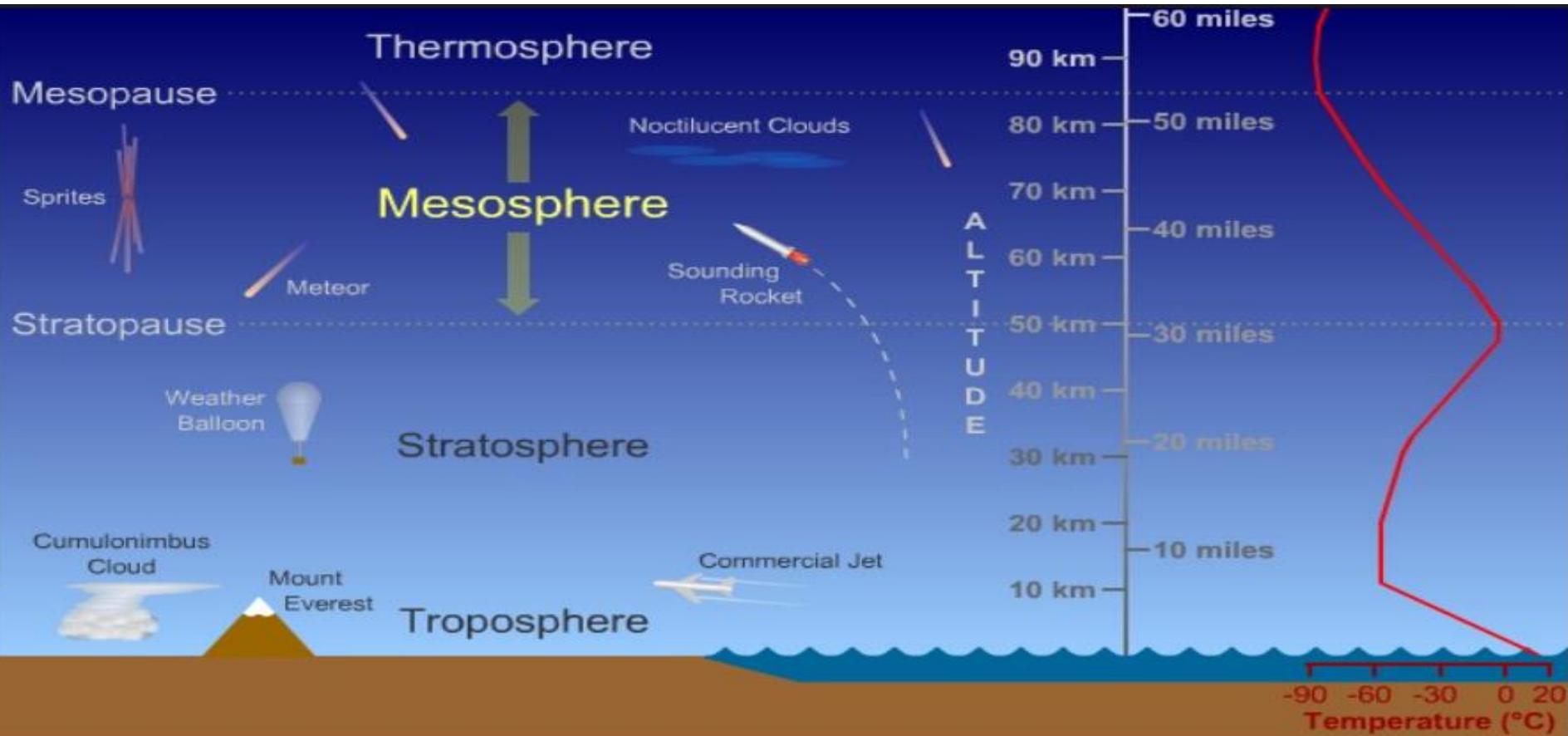
- It is **Scientific Study** of our environment and our place in it.
- Environment science is the study of earth, air, water living organisms and the man with its impact on environment.
- It is highly **multidisciplinary integrating disciplines** of physical, chemical and biological science, geology, mathematics, Sociology etc.
- Environment studies(science) is therefore a multi disciplinary subject where **different aspects** are dealt with a holistic approach.

Components Of the Environment



Components Of the Environment

- **Atmosphere:** The region surrounding the earth is known as atmosphere. Atmosphere is generally a mixture of gases surrounding the earth.



Components of the Environment

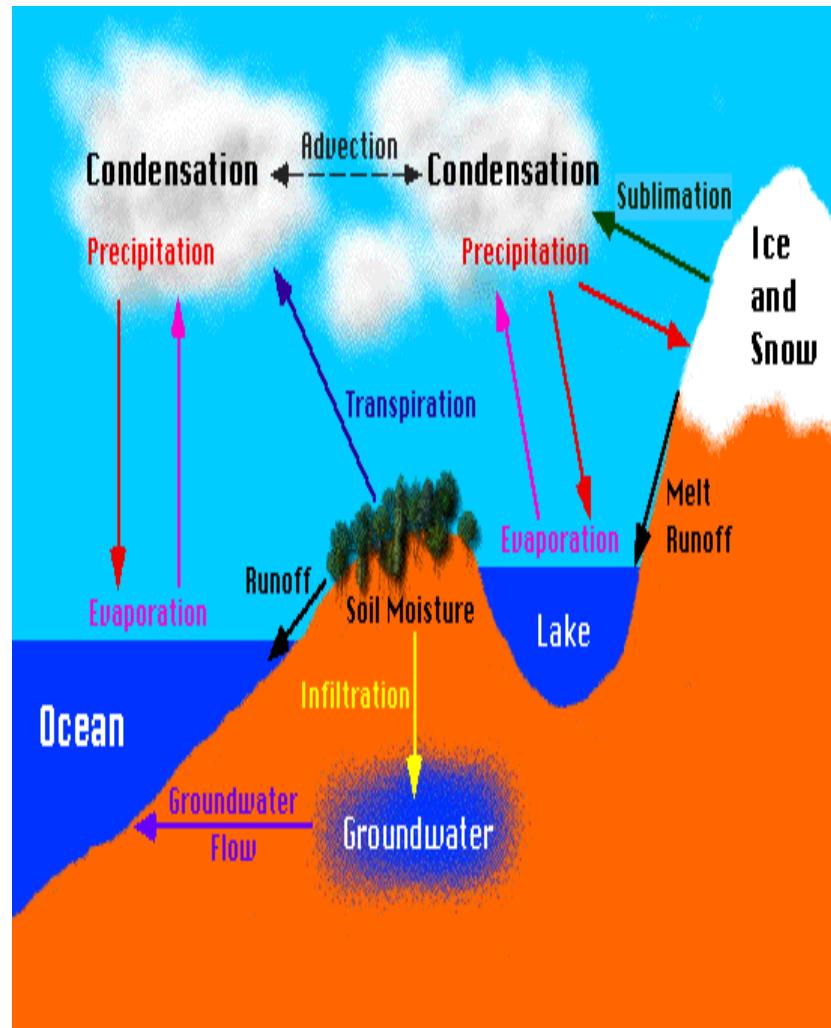
- On the basis of temperature profile and other related phenomena, atmosphere is divided into following major layers.
- Troposphere:- *(0 To 12 Km) Contains 75 % of the gases* in the atmosphere. This is where we live and weather occurs.
- Stratosphere:- *(12 – 50 Km) this layer contains ozone layer*. Ozone acts as a shield for the earth's surface. It absorbs ultraviolet radiations from the sun. This causes temperature increase in the upper part of the layer.
- Mesosphere:- *(50 to 80 Km) This is the coldest region of the atmosphere*. This layer protects the earth from meteoroid. They burn up in this area.

Components of the Environment

- Thermosphere:- (*80 Km and above*) *The air is very thin in this region.* Thermosphere means “Heat Sphere”. The temperature is very high in this region
- Ionosphere:-*This is the lower part of the thermosphere. It extends from 80 Km – 550 Km.* This layer generally helps in radio communication.
- Exosphere:- *The upper part of the thermosphere.* It extends from 550 km and above. Air is very thin here this is the area where satellite orbits the earth.

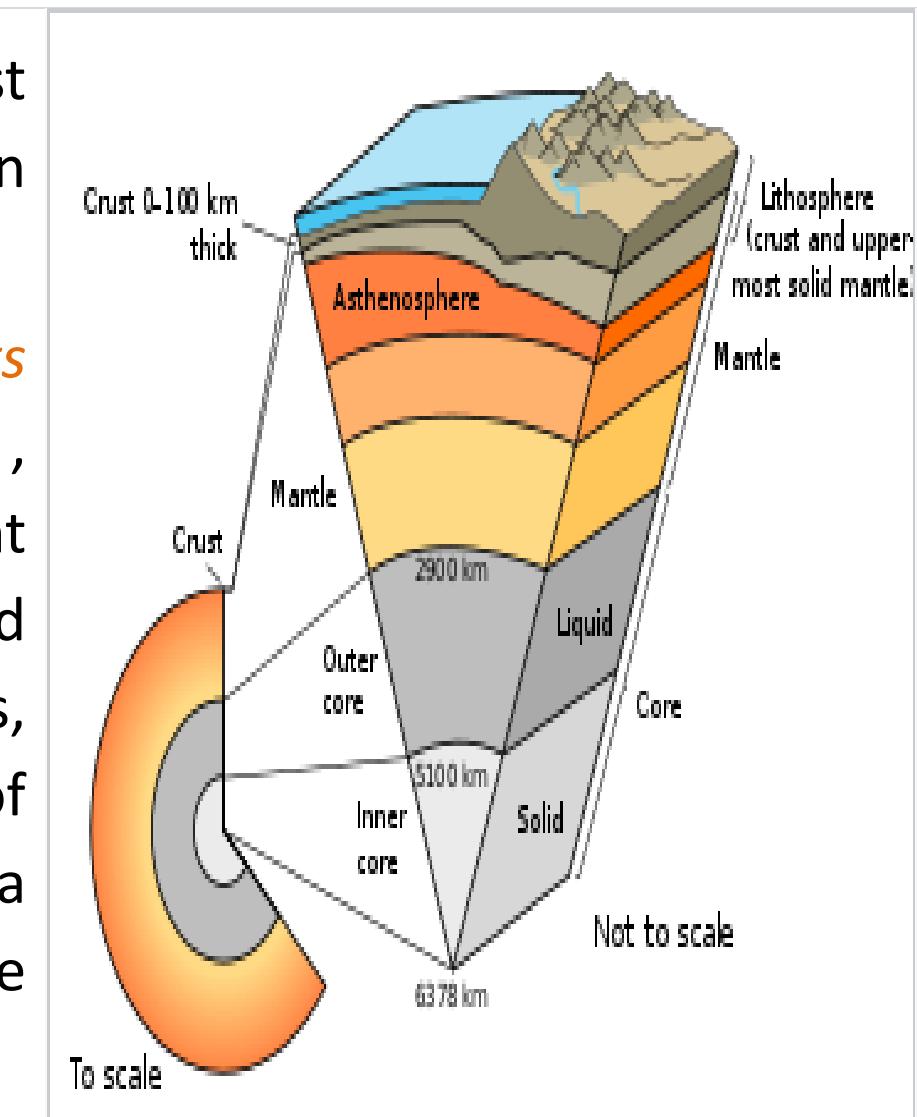
Components of the Environment

- **Hydrosphere:** Hydrosphere is in fact water environment, *about 70 % of earth is covered by water.*
- Water is available in seas, oceans, lake, river, glaciers etc.. It is estimated that the *hydrosphere contains about 1360 million cubic km of water* out of which 97 % is in oceans and sea, 2 % is in glaciers and ice caps while remaining 1 % of fresh water is available for human consumption.



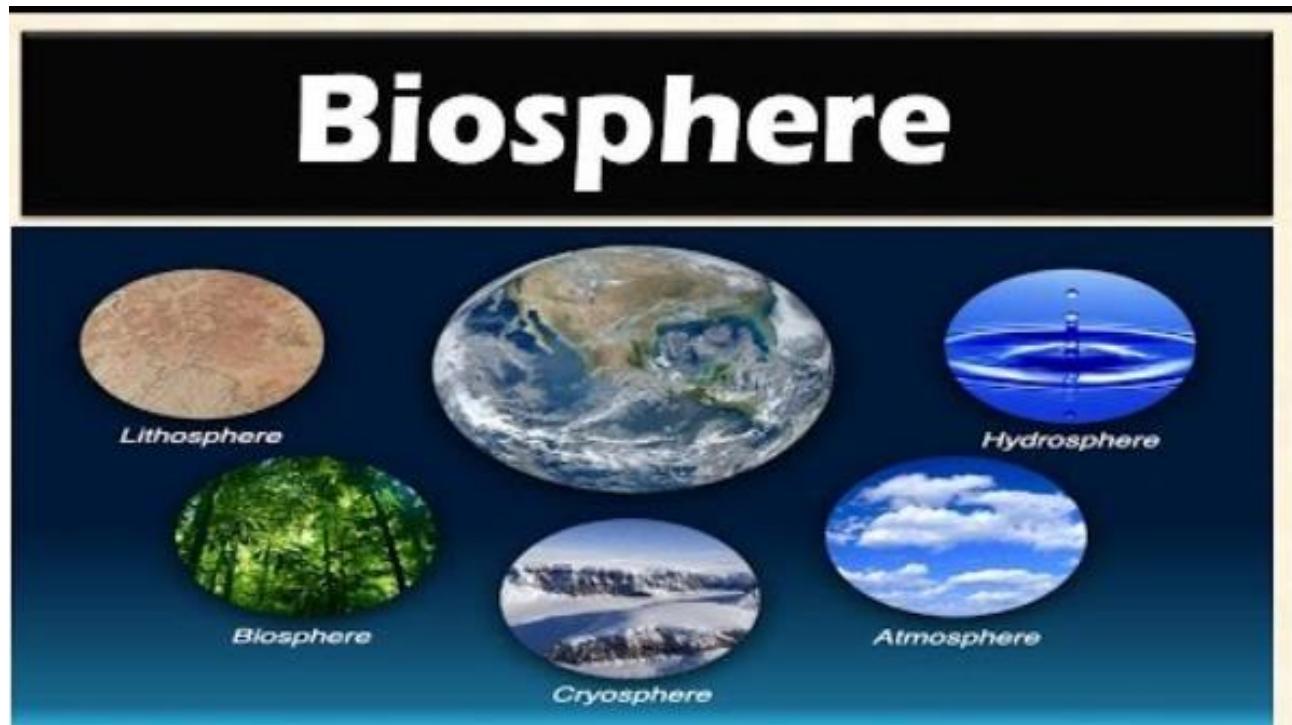
Components of the Environment

- **Lithosphere:** The uppermost part of the *earth crust* is known as Lithosphere.
- Lithosphere includes, *soil and its particles, rocks, metal* etc. , Lithosphere plays an important role as it not only produces food for human beings and animals, but also the decomposition of organic waste is carried out by a host of microorganisms in the soil.

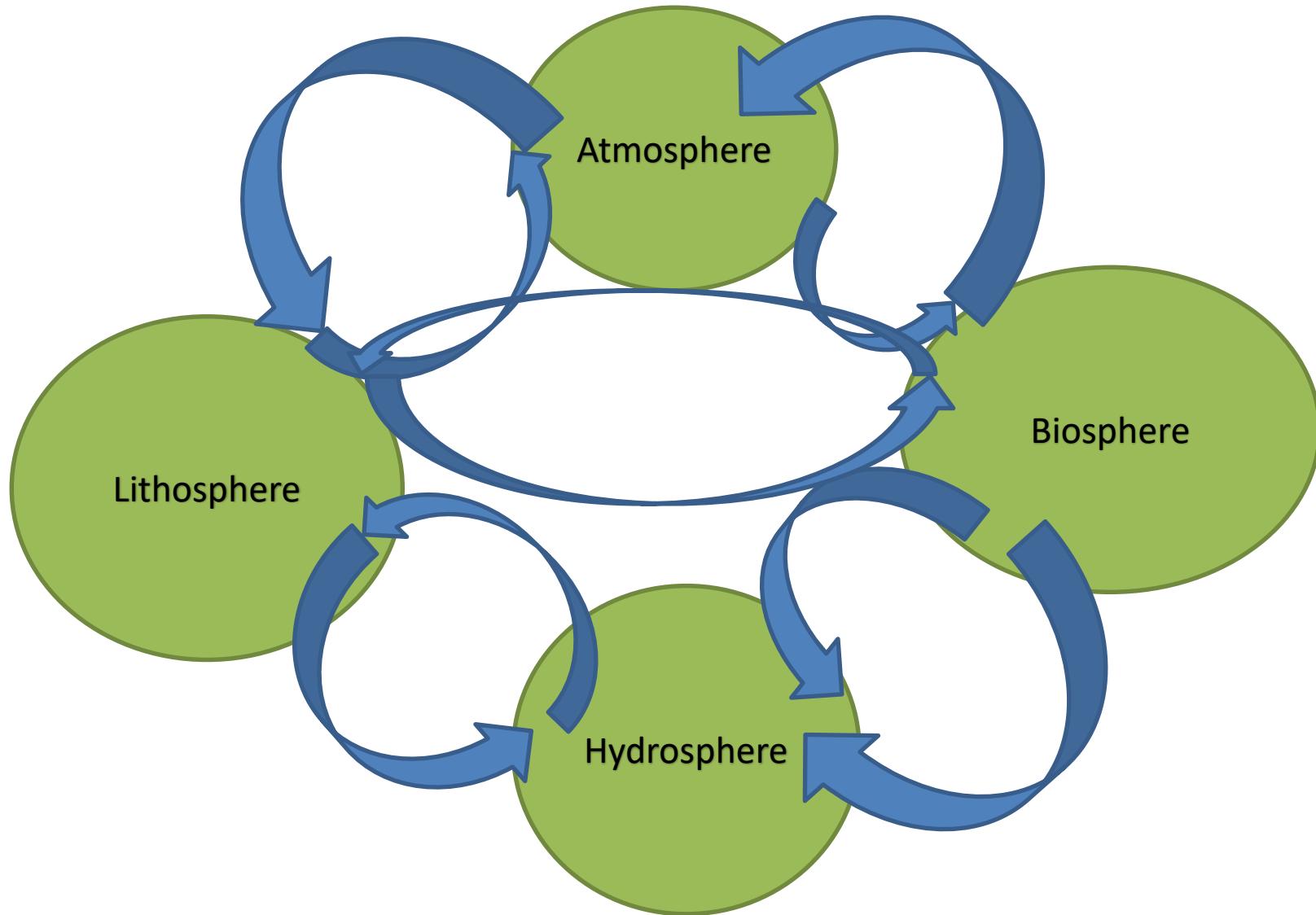


Components of the Environment

- **Biosphere:** The life supporting mantle of the earth extending from few kilometer into the atmosphere to the deep ocean is known as *Biosphere*. The region of the earth where life exist is known as Biosphere.



Interaction between Different Components of the Environment



Interaction between Different Components of the Environment

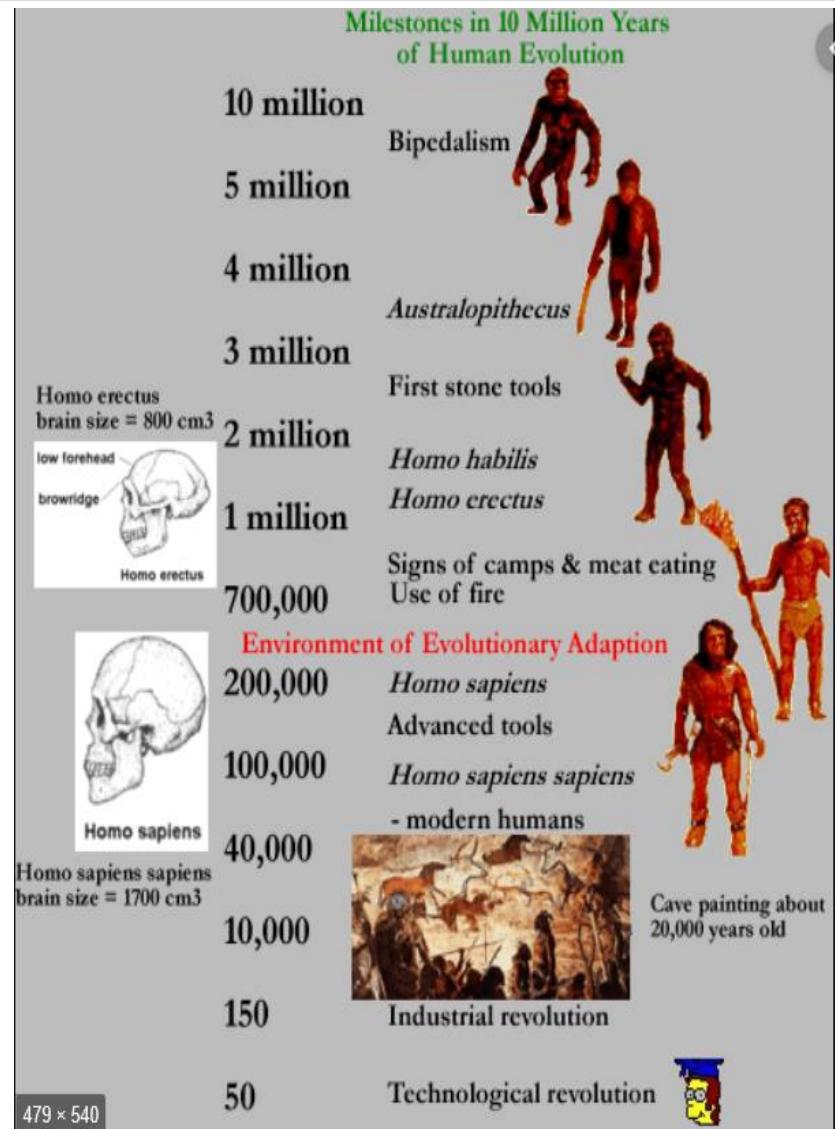
- There are four major environmental components:-**Atmosphere, Hydrosphere, Lithosphere, Biosphere**
- A Schematic representation of four environmental components and their interrelationship is shown in the Figure.
- The circle represents the sphere and the curved arrows indicate the flow path of matter,
- There is a closed, dynamic ,inseparable, organic coupling or **interrelationship** among the environmental components.
- If one of the components or linkages changes, all other components responds.

Interaction between Different Components of the Environment

- Atmosphere may be considered as a **transport components** that moves the substances from atmospheric sources to the receptor.
- Hydrosphere divided in **two systems** one is freshwater and another is the marine .
- The lithosphere is the **solid shell** of inorganics materials on the surface of the earth.
- The biosphere is the thin shell of **organic matter** on the earth surface comprising of all the living organisms.

Man and Environment Relationship:

- The two words Man and environment are not new to the human history and the interrelation between them is well established. Thinking about the environment is as old as our first human ancestors.
- Their survival depended on knowledge of it. Concern for the environment is also not new. Since ancient times, people have known the importance of preserving it.



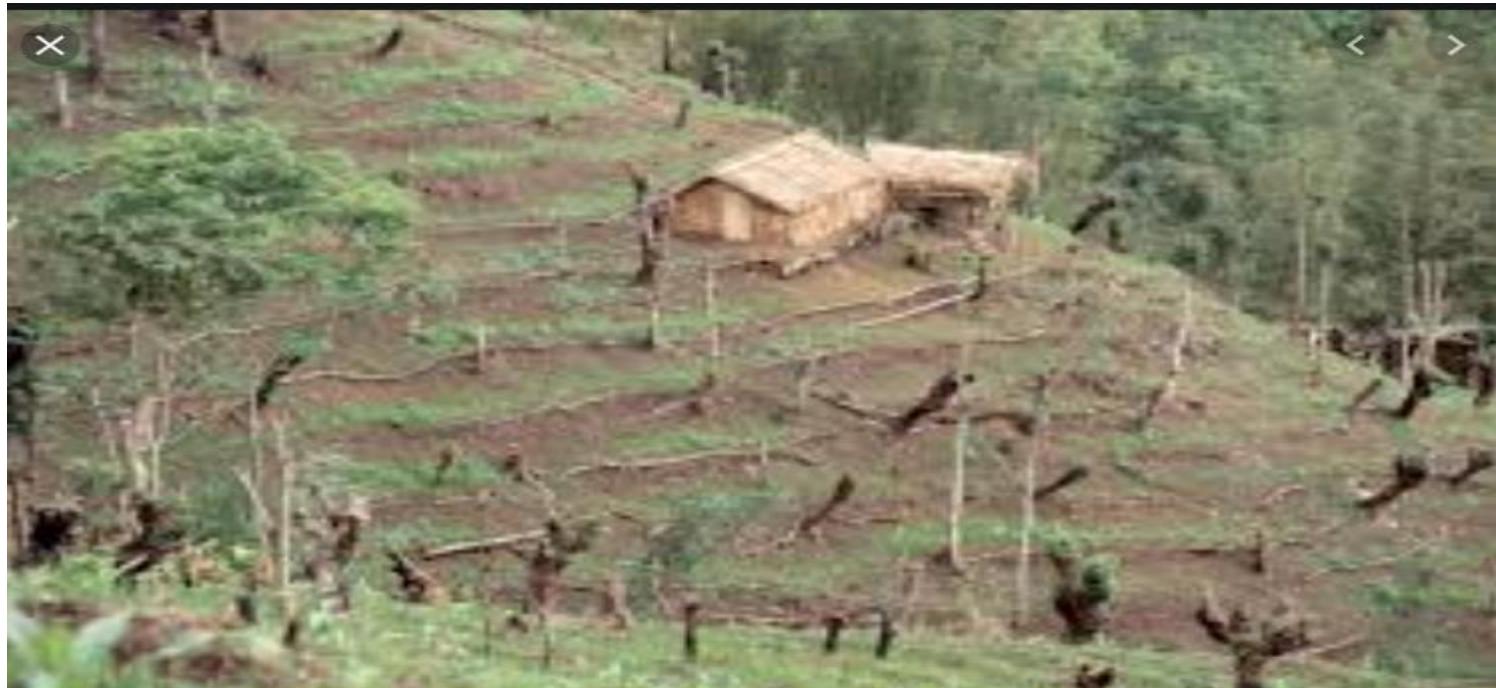
Man and Environment Relationship:

- Worshipping of trees and rivers, animals and the birds was not based on the superstition; but there was a hidden message preserving and protecting of the environment.
- The religious rituals served an important purpose- they made people aware of the environment and its important and so indirectly helped preserve and nourishes it.



Man and Environment Relationship:

- community participation in all those practices that would lead to the maintenance of ecological balance.
- Man is the only living organism capable of modifying its surrounding environment according to the need. Other animals change according to the environment.



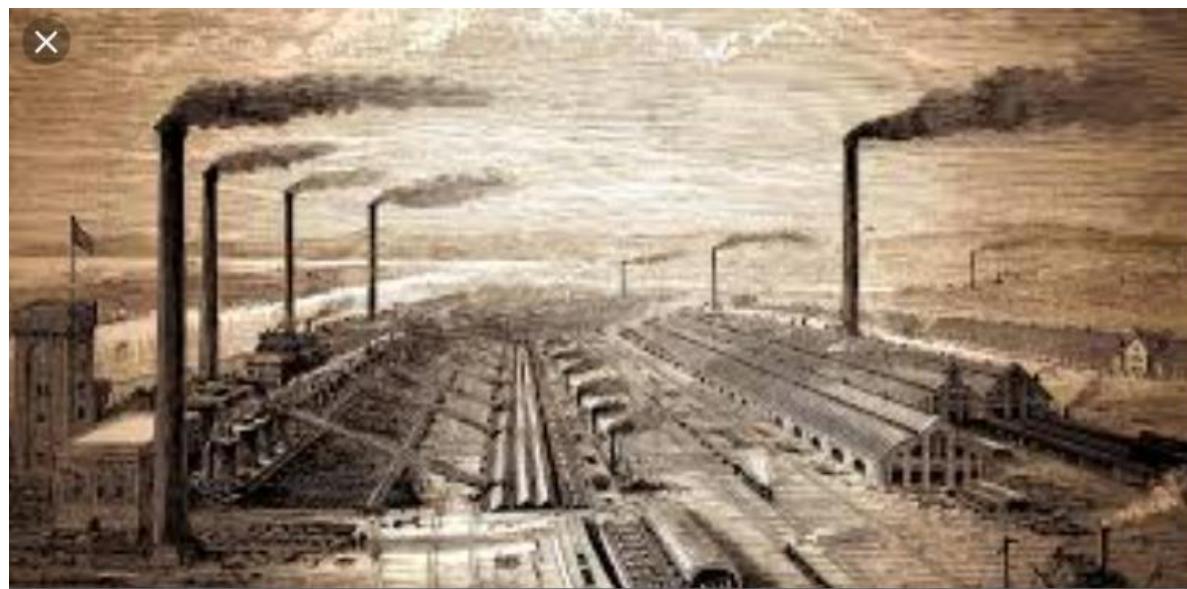
Man and Environment Relationship:

- First man starting hunting the animals and cutting trees for his basics need gradually with the time he started cultivating food grains for that he started hunting animals and cutting trees for his basics needs, gradually with time he started cutting forests and converting them in to grass lands/agricultural fields. To increase his comforts he started disturbing each and every component of the environment.



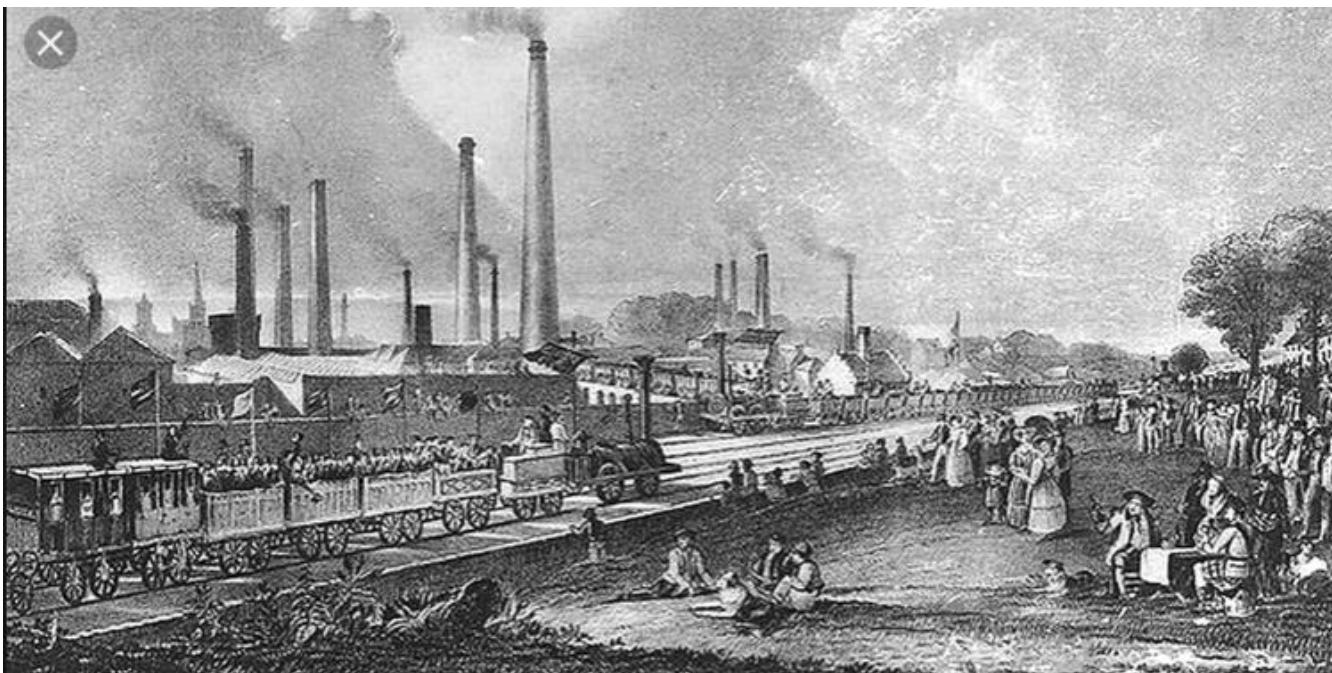
Man and Environment Relationship:

- With the start of the industrial revolution the total scenario changed. Quantity of carbon dioxide emission increased tremendously which has started showing effect in the form of discharge of industrial waste and sewage. Major environmental issues arising due to human activities are global warming, acid rain, ozone depletion and population explosion.



Man and Environment Relationship:

- Emission of CO_2 and the other gases in atmosphere from fossil fuel burning and other human activities may raise the temperature of the earth's lower atmosphere several degrees by 2050. This would disrupt food production and flooding of low-lying coastal cities and croplands.



Man and Environment Relationship:

- An estimated 36500 species of plants and animals become extinct each year, mostly because of human activities.
- The main factors which affect the distribution of population and human settlement are: Relief of land, climate, soils, mineral deposits, water supply...



Environmental Degradation

- Over the centuries we, Indians, have worshiped nature. We have lived in harmony with nature. However, of late, we have followed western countries past of conflict with nature.
- The result is that today, we observe and experience, over all environmental degradation.
- Any objective view of state of environment, of India or any developing countries would clearly show that:



Environmental Degradation

- Soils are eroding.
- Forests retreat.
- Water quality is unsatisfactory.



Environmental Degradation

- Urban air quality is worse.
- Watersheds are losing storage capacity.
- Reservoirs are filled up with sediments.



Environmental Degradation

- Wildlife and their habitats are being eliminated.
- Solids wastes pile up and smolder.
- Costal spawning grounds disappear



Environmental Degradation

- Some of these components have changed to such an extent that cannot be set right by self-regulatory mechanism of the environment. Consequently, the changed environmental conditions adversely affect the living organisms of the biosphere.



Environmental Degradation

- Environmental degradation thus can be **defined as** the lowering of environmental qualities due to the damaged caused by both **natural events** and **human activities** in the basic structure of the environment **at local, regional and global levels adversely affecting all living organism including man.**



Environmental Degradation

- The total environmental degradation and pollution arises mainly due to **consumption of natural resources** by **over population** of the developing countries and **wasteful over consumption of resources** by developed countries.
- IPAT equation popularly known as the impact equation as presented .
- $I = PAT$ {P=population, A= affluence T= Technology}



Environmental Degradation

- Environmental degradation has led to the destruction of the environmental stability and ecological balance. Some of the natural events that cause environmental degradation are volcanic eruption, forests fires, earthquakes, floods.



Environmental Degradation

- Examples of human activities causing pollution and degradation of environment are nuclear explosion, release of toxic gases from automobiles, power plants and various industries etc.



Environmental Education:

- Environmental Education is an integral process, which deals with man's interrelationship with his natural and manmade surroundings, including the relation of population growth, pollution, resource allocation and depletion, conservation technology, urban and rural planning to the total human environment.



Environmental Education: Importance

- The objective of environmental education is to make **public aware** about environmental problem, and importance of environment protection.
- It gives us the basic understanding about **various aspects of environment** and its associated problem.
- It teaches us the concept of **sustainable development**.
- It gives an idea about beneficial **use of natural resources** without damaging it much.
- It teaches us **how to conserve energy** and save our planet.
- It develops skills to identify environmental problems and their solution

Environmental Education: Objectives

- Increase awareness of total environment.
- Increase the knowledge of environment.
- Improve attitude towards environment.
- Provide motivation for environmental protection.



Environmental Education: Principles

- Environmental education **considers environment in totality**.
- It is not a one short learning process but it requires a holistic approach as it **multidisciplinary in nature**.
- Environmental hazards are controllable and every citizen has a **moral obligation and responsibility towards** this. Education must be given to all section of the society.
- Help learner to **discover the systems and causes** of environmental problems.

Importance of Different Engineering Disciplines:

1. Mechanical Engineering:-

- it deals with design and operation of many combustion processes.
- He/she try to increase the efficiency of combustion process, as incomplete combustion leads to production of carbon dioxide and other air pollutants.
- Use of refrigeration which have higher global warming potential , which may eliminate the use of these environmentally.

2. Civil Engineering:-

- Demolition and construction waste are produce in large quantity in various works related to civil engineering.
- If a civil engineering is aware of the problems cause in handling and disposing of waste.

Importance of Different Engineering Disciplines:

3) Electrical Engineering :-

- Producing energy by **conventional energy sources** causes depletion of **natural resources** and **large amount** of pollution.
- Power sector is one of the largest contributor.
- Basic knowledge of different types of **pollutant produce in power generation** and their impacts on environment.

4) Computer/IT Engineering:-

- It includes of e-waste, its source and impacts on the environment.
- Computer engineers with a **sound knowledge of environmental science** would try to develop technologies which can be used to upgrade existing computer and IT gadgets easily thereby reducing need of **replacing the existing one**.

Chapter-2

Water Pollution

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Topics to be covered

- Introduction
- Sources of water pollutant
- Classification of water pollutant
- Effects of water pollutants
- Control of water pollutants

Introduction

INTRODUCTION TO ENVIRONMENTAL POLLUTION

- Environmental pollution can be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the environment (i.e. air, water and land) which can cause harmful effects on various forms of life or property.



Introduction

- **Pollutant**
- A pollutant may be defined as any substance present in the environment in such concentration that alter the quality of environment and affect the living things adversely.

Or

- Pollutant is defined as the substances that actually cause pollution.



TYPES OF ENVIRONMENTAL POLLUTION

- Water pollution
- Air pollution
- Land pollution

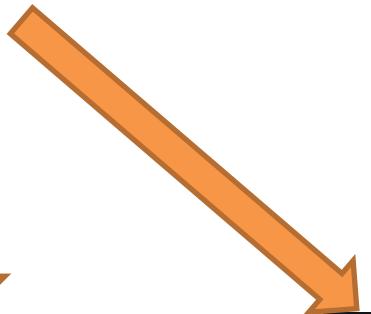


TYPES OF ENVIRONMENTAL POLLUTION

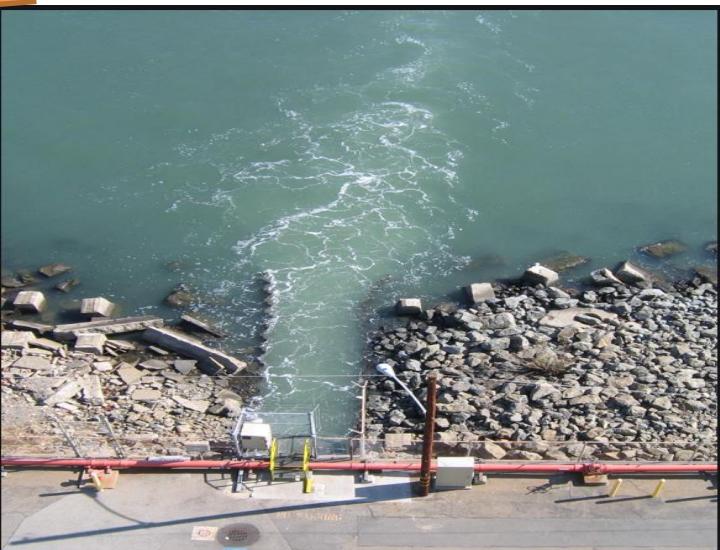
- Noise pollution



- Thermal pollution



- Marine pollution



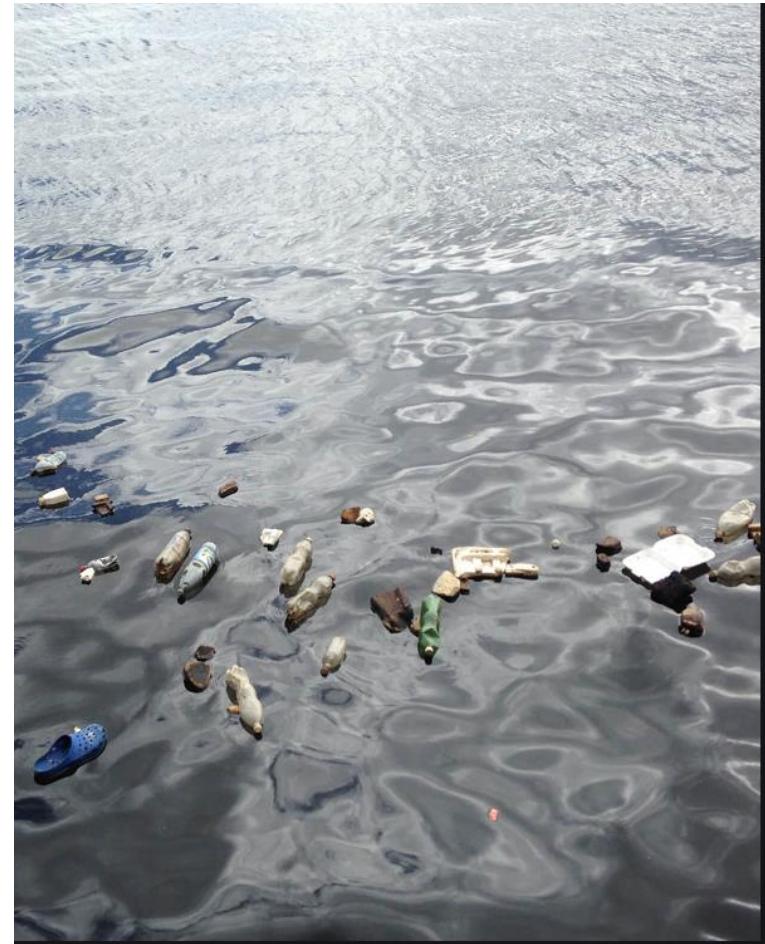
Water Pollution

- **Water pollution** can be defined as alteration in physical, chemical or biological characteristics of water through natural or human activities making it unsuitable for its designated use.



Water Pollution

- Any physical, chemical or biological change in water quality that adversely affects living organisms or makes water unsuitable for certain uses is referred as **water pollution**.
- Fresh water present on the earth surface is put to many uses. It is used for drinking, domestic and municipal uses, agriculture, irrigation, industries, recreation etc.



Signs of polluted water

- Bad taste of drinking water.
- Offensive odours from rivers, lakes and oceans.
- Decrease in number of fish in fresh water and sea water.
- Oil and grease floating on the surface.
- Unchecked growth of aquatic weeds in water bodies.
- Presence of colour due to organic matter.



Types of water

- **Pure form of water:** In the form of H_2O , also known as **distilled water**.
- **Mineral water:** Water with **acceptable limits of minerals** specified by potable water standards.
- **Tap water:** Water supplied by the concerned authority available at homes.
- **Polluted water:** Water containing **impurities** not suitable for drinking.
- **Contaminated water:** Water containing **harmful impurities**, not suitable for any purpose nor even can be thrown in water bodies.

Water quality Standards:-

Main parameters which are required to be tested for determining the quality of water can be divided into.

(1) Physical (2) Chemical (3) Biological/Microbiological

(1) Physical parameters

- Turbidity
- Colour
- Odour
- Taste
- Temperature

Water quality standards

(2) Chemical Parameters

- Solids (suspended, dissolved, volatile)
- Hardness
- Chlorides
- pH
- Dissolved gases like Oxygen Carbon Dioxide, Hydrogen Sulphide
- Nitrogen compounds like Nitrites, Nitrates, Ammonical Nitrogen, Albuminiod Nitrogen
- Metals and other inorganic substances like Fluoride, Iron & Manganese, Lead, Arsenic, Iodides, Boron Cadmium

Water quality standards

(3) Biological parameters

- In Biological parameters includes various microorganisms like bacteria, virus, protozoa, worms present in water it may be pathogenic or non pathogenic.
- The agencies playing an important role in specifying the norms for various effluents to be discharged in the water bodies as well as for drinking water are:
 - Indian Standards Institution (ISI)
 - World Health Organization (WHO)
 - United States Public Health Services (USPHS)
 - Indian Council of Medical Research (ICMR)

Sources of water pollution

- Sources of water pollution can be classified as
 - (1) Point Sources
 - (2) Non Point Sources

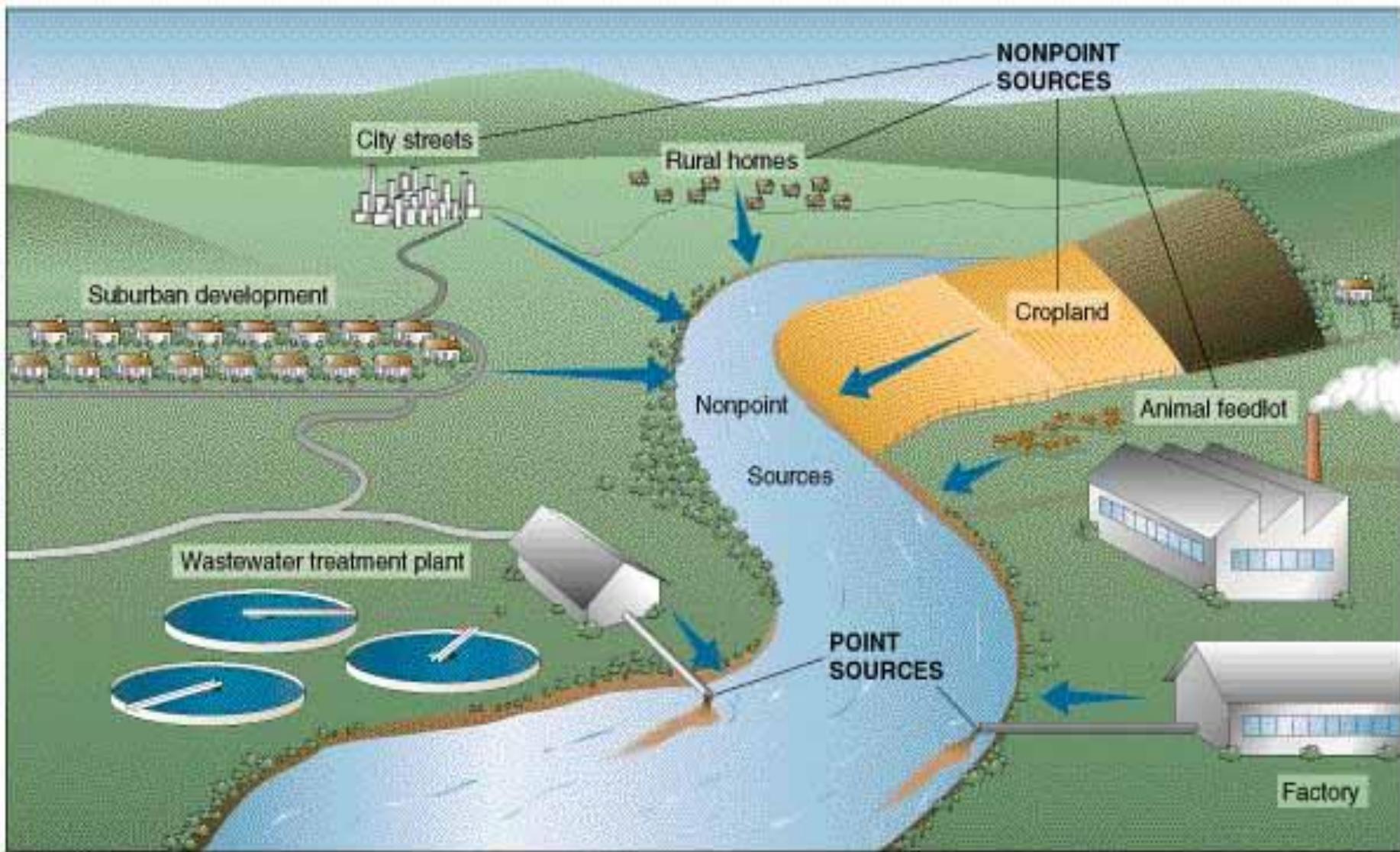
(1) Point Sources

- Those sources which can be identified as a single location are called point sources.
- Examples of point sources are industrial effluent, power plants, sewage discharge etc.
- It is possible to minimize the water pollution from the point sources if the waste water is collect and is given some treatment before it is discharged into a water body.

Sources of water pollution

(2) Non point sources

- Non point sources which are also called as area or diffused sources.
- Those sources whose location cannot be easily identified are called non point sources.
- The discharge from this sources is not at any particular site, rather these are scattered, which individually or collectively pollute the water.
- Example of non point sources are surface runoff from agricultural fields, overflowing small drains, rain water sweeping roads and fields etc



Sources of water pollution

- Major sources of surface water pollution are:
- Sewage: discharge of sewers and drains.
- Industrial effluents from different industries.
- Synthetic detergents used for washing and cleaning.



Sources of water pollution

- Agrochemicals like fertilizers containing nitrates and phosphates and pesticides used in agricultural fields which come in runoff from the agricultural land.
- Oil spillage during drilling and shipment.



Sources of water pollution

- Waste heat from industrial discharge increases the temperature of the water bodies.
- Major sources of ground water pollution are septic tanks, deep well injection of industrial effluents, mines etc.



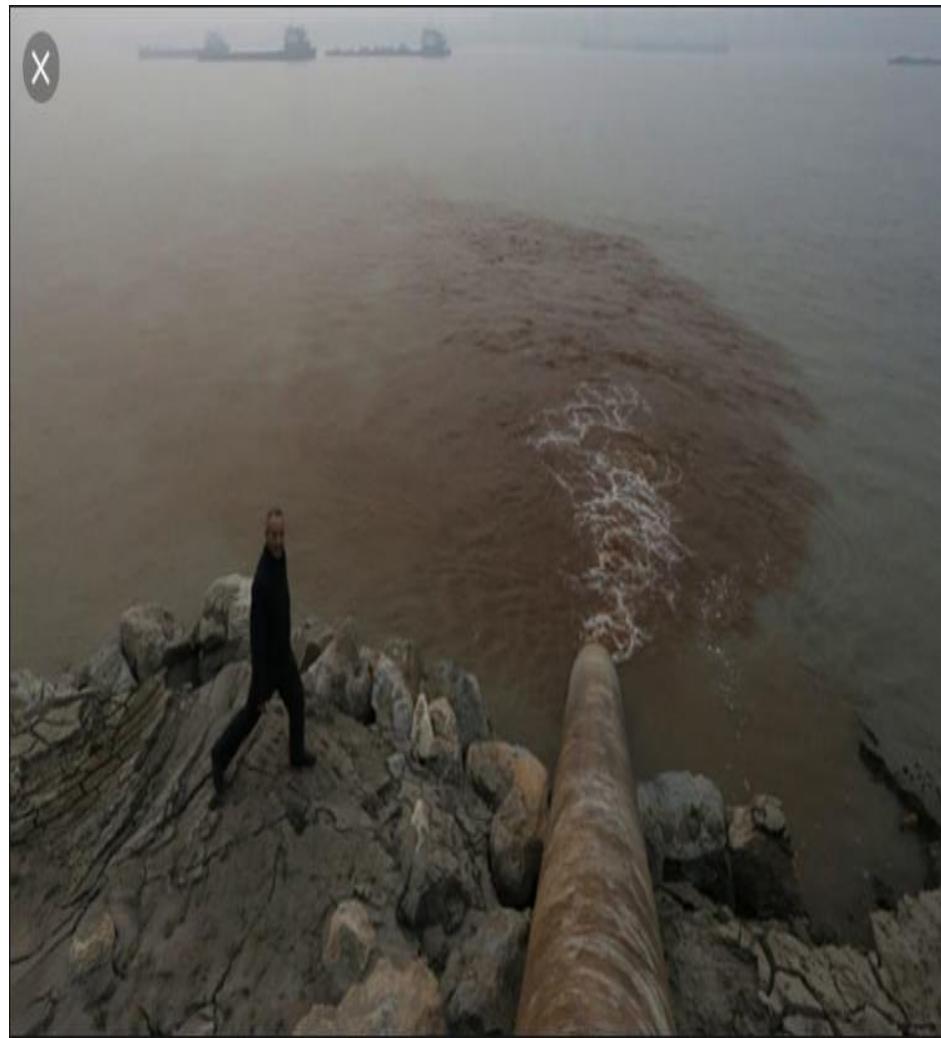
Classification of Water pollutants:

1. Inorganic Pollutant
2. Organic Pollutant
3. Suspended Matter
4. Radioactive Pollutant
5. Thermal Pollutant
6. Synthetic Organic Compound (Nutrient)
7. Pathogens (Bacteria, Virus, Protozoa, Worms)
8. Sediment

Classification of Water pollutants:

Organic pollutants:

- The organic pollutant means “**oxygen demanding pollutants**”.
- The organic pollutants are present in domestic sewage, plant nutrient, oil waste from food processing industries, dairy, pesticides waste etc.



Classification of Water pollutants:

- The most organic waste is biodegradable in nature hence it can be break down and used as food for micro organisms.
- The aerobic bacteria uses dissolved oxygen from the water and deplete the level of dissolve oxygen for the decomposition of organic matter.



Classification of Water pollutants:

Radioactive Compounds:

- The source of radio active compounds are nuclear power plants, medicated radioactive use in hospital and scientific use of radioactive material from laboratories, uranium and thorium mining etc.
- These wastes are highly toxic and cause birth defects, generic damage and cancer.



Classification of Water pollutants:

Thermal Pollutants:

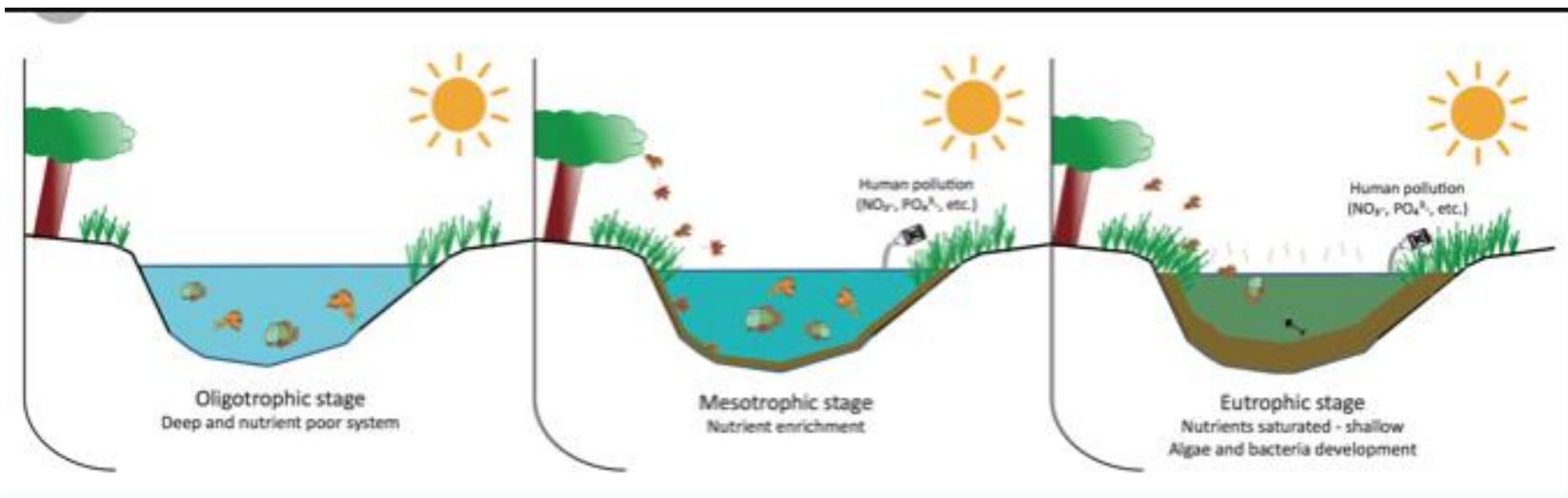
- The thermal power plant based on coal fired or nuclear fuel fired is the major source of thermal pollution.
- These thermal plants release hot water and discharge into near by water body.
- The hot water discharge increase the temperature of water body and kills the aquatic creature.



Classification of Water pollutants:

Nutrients:

- The sewage and **agriculture runoff waste** from fertilizer and detergent industries contents phosphate and nitrogen in large quantity.
- Such runoff is **discharge into water body** then it results into over nutrition in water which is called eutrophication.
- The result is the formation of aquatic **weeds and vegetable** which again is the headache for public water supply.



Classification of Water pollutants:

Inorganic Pollutants:

- The inorganic pollutants are inorganic salts, mineral acids, toxic metals, some trace element etc.
- The inorganic pollutant makes water unfit for domestic purpose and cause danger of life for aquatic creature.



Classification of Water pollutants:

Suspended matter:

- The soil erosion is the main source for accumulation of sediments/suspended matter in water body.
- The other source is solids from domestic sewage and solids from construction activities.
- The suspended matter inhibits the penetration of sunlight in water body which results into decrease rate of photosynthesis process



Effects of Water pollutants:

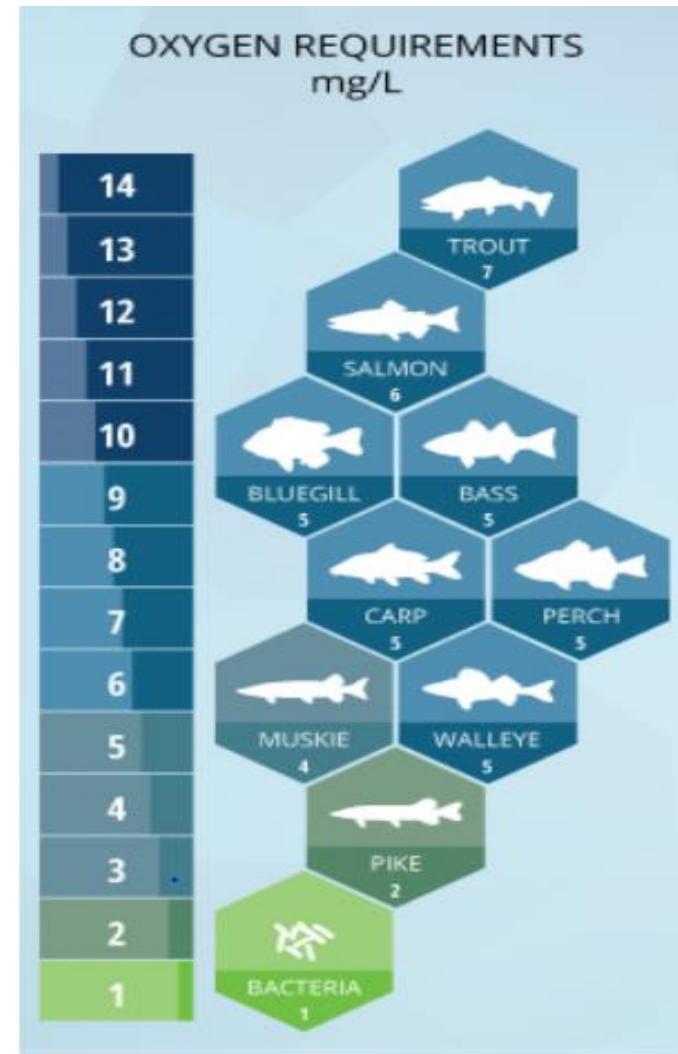
- Following are some important effects of various types of water pollutants:

Oxygen demanding waste (Biodegradable organic waste)

- Organic matter which reaches the water bodies is decomposed by microorganisms present in water. For this oxygen dissolved in water is used.
- $\text{ORGANIC MATTER} + \text{DO (O}_2\text{)} + \text{Bacteria} \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$
- **Biochemical Oxygen demand (BOD)** is used to as a measure to find out the amount of Biodegradable matter in the water.
- It is defined as amount of oxygen required by the bacteria to decompose the biodegradable organic matter under aerobic condition.
- The saturated value of DO in water is in the order of 8 to 10 mg/L.

Effects of Water pollutants:

- Optimum DO required for healthy fish and other aquatic life is about 5-8 mg/L.
- Due to degradation of waste DO levels gets reduced. If DO drops below 4 mg/L fish and other aquatic life is threatened and in extreme cases killed.
- Other effect of reduced DO is undesirable taste, odour and colour prohibiting its use for domestic and recreational purpose.



Effects of Water pollutants:

Pathogens

- Many wastes water especially sewage contains many pathogenic microorganisms which are usually contained if faces and urine of infected persons.
- Water borne diseases like cholera, dysentery, typhoid are caused due to pathogens present in water.



Effects of Water pollutants:

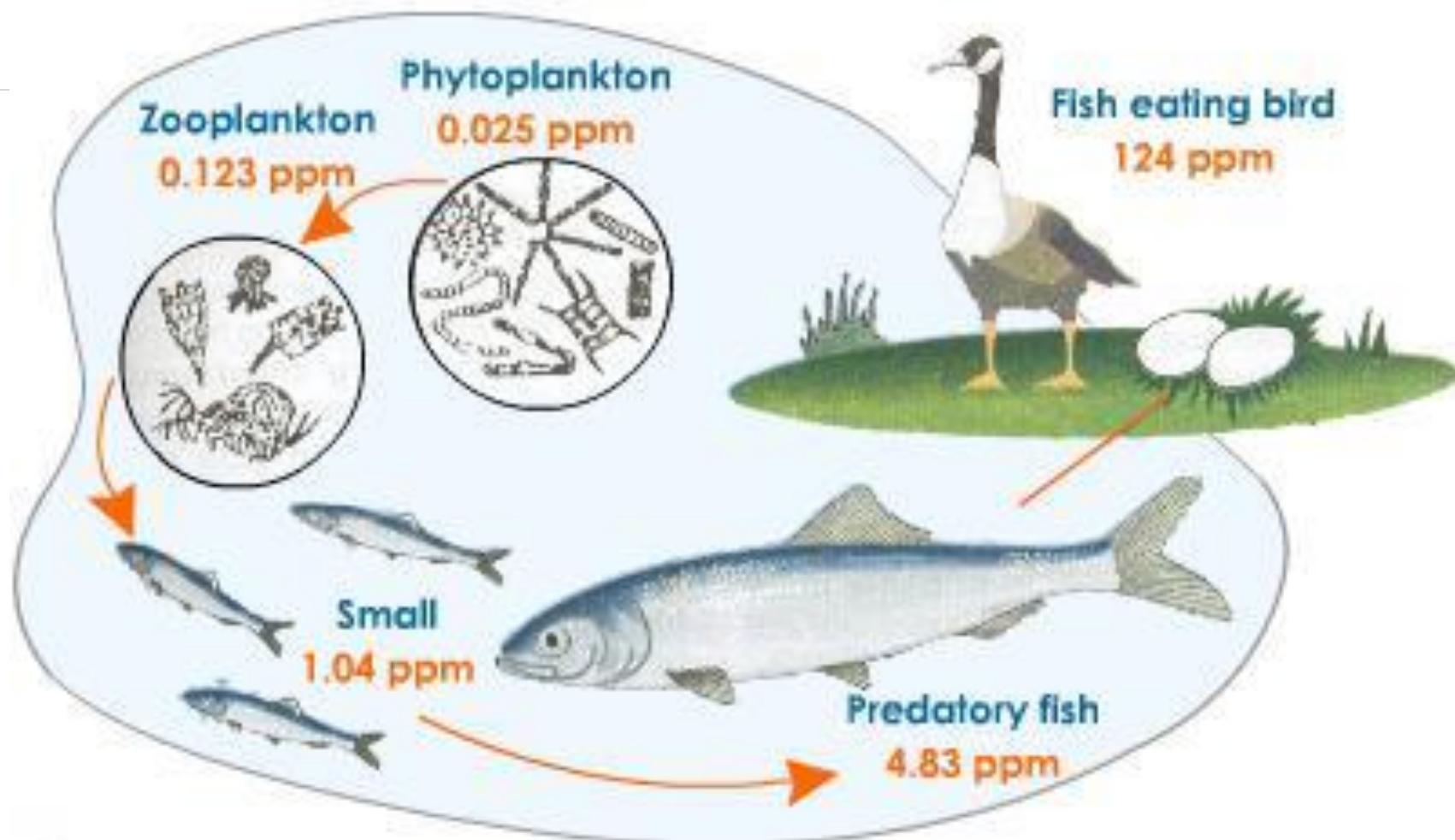
Nitrogen and phosphorus compounds (Nutrients)

- Additional of compounds containing nitrogen and phosphorus helps in growth of algae and other plants. These compounds are nutrient for growth.
- When these concentrations are high it causes rapid growth causing algal bloom. Also the growth of weeds increases.
- It covers up the water surface and prevents entry of sunlight into water bodies.
- Aquatic plants along with algae thus die; the bacteria present in water now decompose all these dead plants.
- The decayed organic matter adds unwanted colour, odour and taste to water.
- It also reduced DO of water and leads to death of fish and other aquatic animals.

Effects of Water pollutants:

Toxic Compounds

- Pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to aquatic organisms.
- Some of the substances like pesticides, methyl mercury etc moves in to the bodies of organisms from medium in which these organisms live.
- These substances tend to accumulate in the organisms body. This process is called **Bio accumulation**.
- The concentration of these toxic substances builds up at successive levels of food chain. This process is called **Biomagnification**



Process of Biological Magnification;
DDT concentrations increase in organisms along the food chain

Effects of Water pollutants:

- Following example of biomagnification of DDT in aquatic chain.

Components	DDT Concentration (ppm)
Birds	10.00
Needle fish	1.0
Minnows	0.1
Zooplankton	0.01
Water	0.000001

- Mercury** dumped in water is converted to methyl mercury by bacterial action. A disease called Minimata dieses occurs due to consumption of methyl mercury contaminated fish.
- Concentration of **nitrate** more than 45 mg/L causes occurs blue baby diseases in infants.
- Excess fluoride causes fluorosis. It effects the bones and teeth of the person.

Effects of Water pollutants:

Suspended matter

- Makes water aesthetically displeasing.
- Biodegradable suspended matter causes DO depletion.
- It reduced light penetration there by reducing photosynthesis and a corresponding loss in food production.
- Provides adsorption sites for harmful chemicals or biological organisms which can effect flora and fauna of stream.

Effects of Water pollutants:

Thermal Discharge

- Water is used for dissipation of waste heat in power plant and industries. This heated water is subsequently discharged into water bodies. Increased temperature of water has following effects:
- Increases biological activities.
- Cause death of some heat sensitive organisms.
- DO concentration decrease this together with increased biological activities at high temperature may result into anaerobic condition. Resulting in bad odour.
- Growth of algae increases.
- Toxicity of chemical pollutants increases with increases in temperature.

Eutrophication:-

- The word Eutrophication is originated from Greek words eu=well and trophes= food. Thus meaning is “well fed” or “nutrient rich”.
- Thus we can define eutrophication as excessive nutrient load in a water body or enrichment of water body by nutrients like phosphorus and nitrogen.
- Presence of nutrients is must for growth of organisms, but if these nutrients are present in excessive amount then they act as pollutants because they allow excessive growth of aquatic plants like algae.

Eutrophication:-

- Depending upon the presence of nutrients, the water bodies (aquatic system) may be classified as under:

(1) Oligotrophic:

Water bodies with poor concentration of nutrients and very low productivity of aquatic plants.

(2) Mesotrophic:

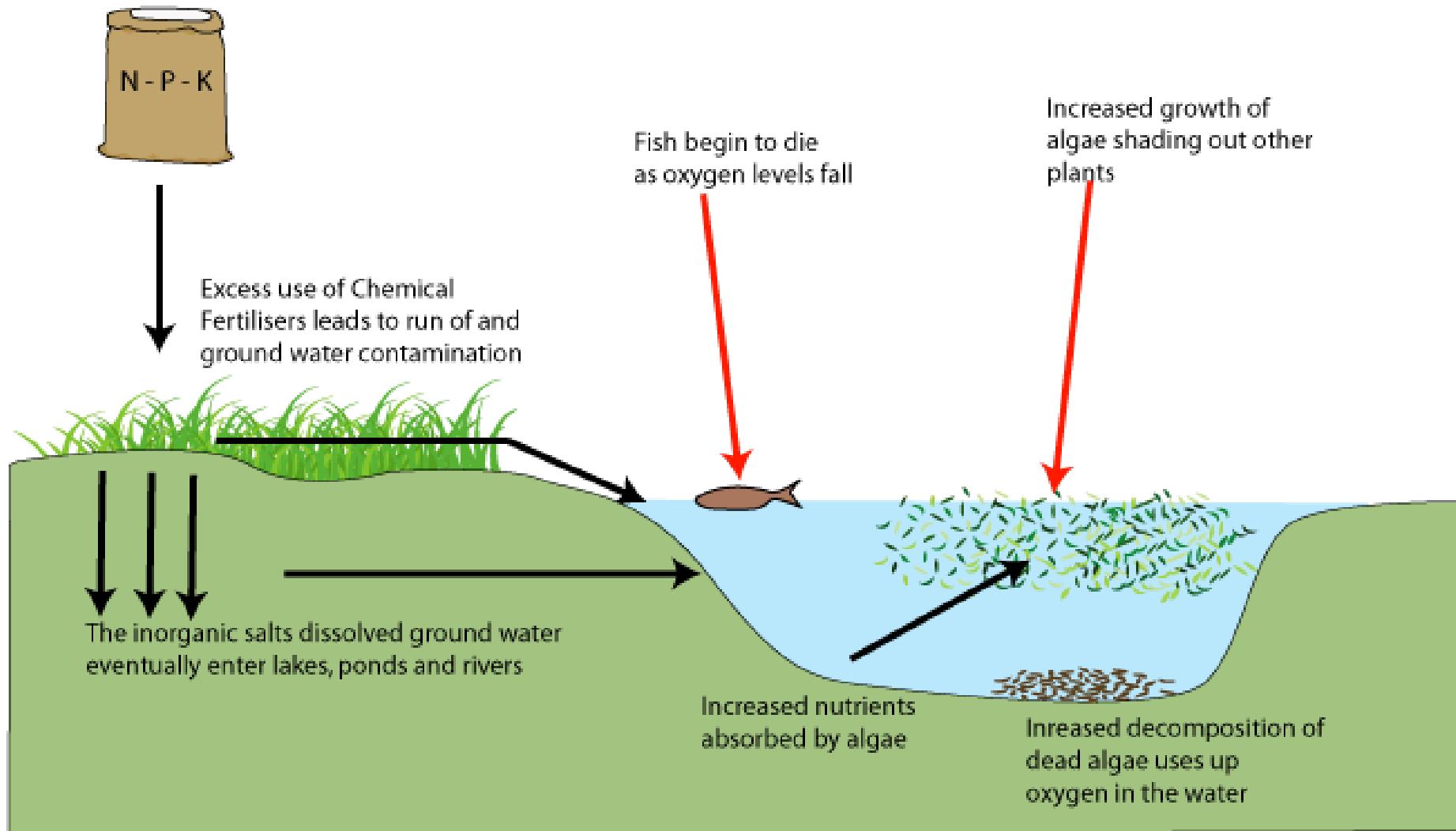
Water bodies with moderate concentration of nutrients and average productivity of aquatic plants.

(3) Eutrophic:

Water bodies with high concentration of nutrients and very high productivity of aquatic plants.



Eutrophication



Eutrophication:-

What causes eutrophication?

- Newly formed water bodies such as lakes, ponds and reservoirs, whether natural or man-made has low nutrient content and low plant productivity.
- Gradually, with the passage of time these water bodies become rich in nutrients through the deposit of domestic waste, agricultural residue (rich in nitrogen and phosphorus), and industrial waste etc which ultimately increase aquatic growth.
- In this way the oligotrophic water bodies turns gradually into Mesotrophic water body.
- Natural eutrophication is a very slow process, often taking more than 100 years. But artificial eutrophication is very fast as it depends on the input of organic waste matter.
- The aerobic decomposition of organic waste in the presence of oxygen by bacteria leads to eutrophication.

Eutrophication:-

- The nutrient rich water body supports the **growth of algae** and the entire **water body becomes green**.
- As more plants grow due to the **additional supply of nutrients**, more plants also die.
- Bacteria decompose these dead plants and organic waste using dissolved oxygen. As a results, BOD of water increases.
- **Fish and other aquatic animals start dying due to the depletion of oxygen.** Such a water body is said to be eutrophied.
- With an increase in BOD, water starts emitting an offensive smell and asthetic and recreational importance of the water body decreases.
- Generally, it is observed that concentration of nitrogen higher than 0.3 mg/L and phosphorus more than 0.15 mg/L cause eutrophication

Eutrophication:-

Effects of eutrophication:

- Higher growth rate of algae in the water body.
- Algae bloom restrict the penetration of sunlight in water body hence rate of photosynthesis process decreases.
- Decrease in dissolved oxygen (DO) and increase biological oxygen demand (BOD).
- Bad taste, bad odour is produced and also increases in turbidity of water.
- The decaying organic matter causes depletion of DO, destroying fish and other aquatic species.
- Aesthetic and recreational importance of the water body decreases i.e. fishing, swimming, boating etc.

Eutrophication:-

Control of eutrophication

- The control at sources is the best practice to prevent eutrophication therefore waste water enrich with nutrient should be treated for removal of nitrogen, phosphorus and carbon before disposal.
- Recycling of nutrient should be adopted.
- Algae bloom should be removed the water body.
- Reducing the use of phosphate in detergents.
- Reducing the use of nitrate containing fertilizers.
- .

Control of water pollution

Water pollution can be checked or at least reduced by following measures:

- By proper sewage treatment:**

The sewage should be properly treated before disposing it in any water bodies.

Sewage should be given following treatment before discharging into water bodies

Primary treatment:

To remove floating impurities, girt, inorganic particles, settable solids etc. It mainly involves physical method for removal of impurities.

Secondary treatment:

Mostly aimed to remove organic impurities using mainly biological methods.

Tertiary treatment:

Mostly using strong oxidizing agents to remove impurities. Example chlorine gas.

It is used to remove the impurities remaining after primary and secondary treatment.

Control of water pollution

- The industrial effluent should be properly treated before discharging it into water bodies.
- By enforcing stringent standards for disposal of sewage and industrial waste into water bodies.
- By prohibiting direct washing of clothes and animals in water bodies used for drinking water supply.
- Pesticides and fertilizers should be judiciously used to reduce chemical pollution due to surface runoff from farms. Less stable pesticides should be used.
- Increasing the vegetative cover to reduce water pollution due to soil erosion.
- Encouraging reuse of water.
- To avoid thermal pollution hot water should be cooled before releasing it into bodies.
- Advanced treatment for removal of nitrates and phosphates should be adopted to prevent eutrophication.

Chapter-3

Air Pollution

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Topics to be covered

- Introduction
- Sources of air pollutant
- Classification of air pollutant
- Effects of air pollutants
- Control of air pollutants

Definition of Air pollution

- “Air pollution is defined as the presence of unwanted and undesirable foreign particles and gases (in sufficient quantity and duration) in the air which may have adverse effects on human being, animals, plants, vegetation's and important structure.



Sources of Air Pollution

Sources of air pollution can be mainly classified into

- (a) Natural
- (b) Man- made

(1) Natural Sources

- Pollen grains
- Volcanic eruption
- Forest fire
- Salt spray from oceans
- Dust storms
- Marshy land
- Bacteria and other microorganisms
- Photochemical reaction

Sources of Air Pollution

(2) Man made sources

- Industrial units
- Thermal power plants
- Automobile exhaust
- Fossil fuel burning
- Agricultural activities
- Mining
- Air crafts
- Nuclear explosion
- Domestic burning of woods

Sources of Air Pollution

Man made sources can be generally classified into

(a) Point or stationary sources:

- Industrial unit which add pollutant to air at particular points from their tall chimney.

b) Line or mobile Sources:

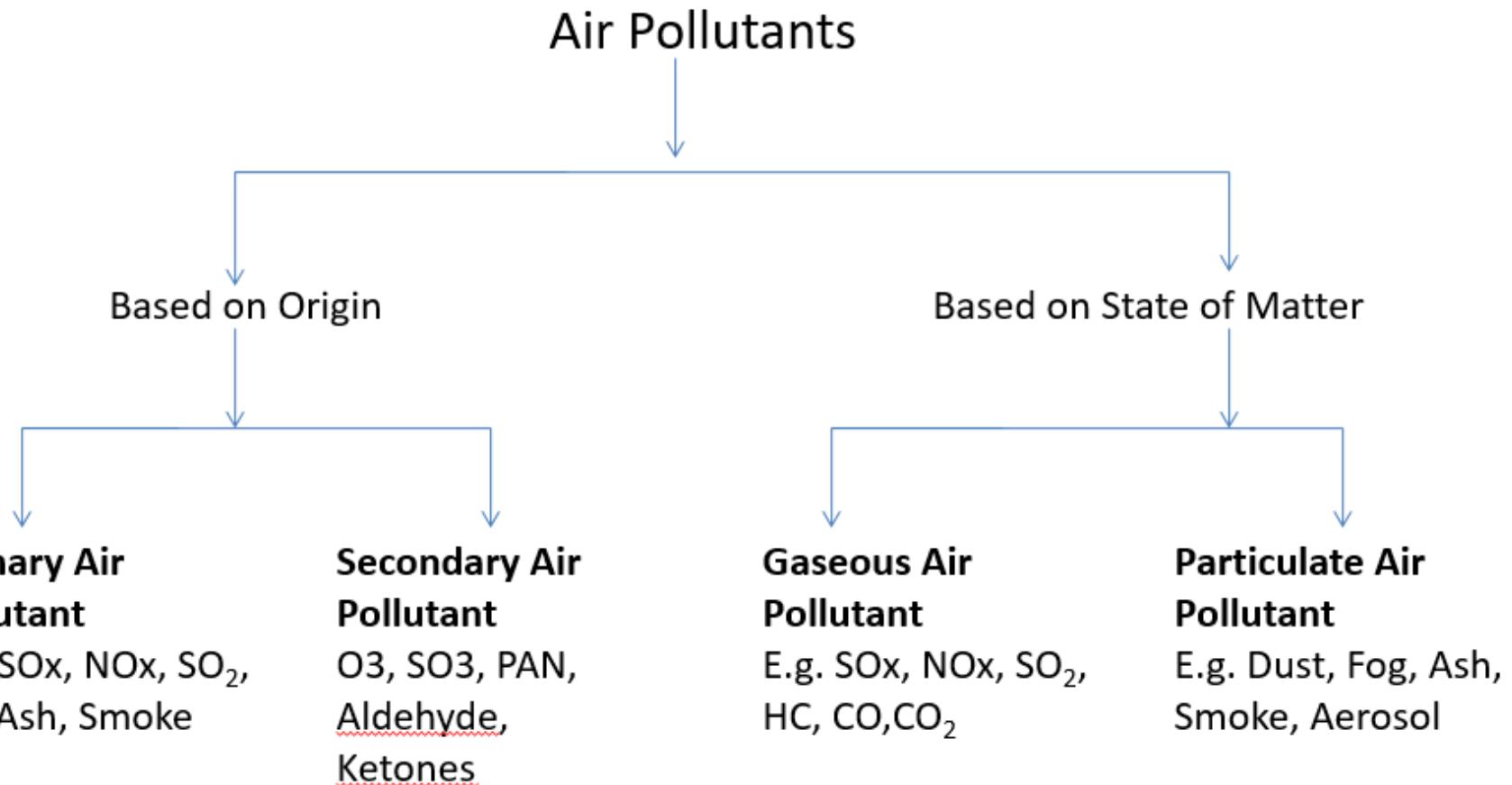
- This sources of air pollution are the automobile as these add pollutants along a narrow belts and over long distance.

(C) Area sources:

- Town and cities add smoke and gases over wide areas.



Classification of Air pollutants



Classification of Air pollutants

A. Classification based on origin of air pollutants

- (1) Primary pollutants**
- (2) Secondary pollutants**

(1) Primary pollutants:

- These are emitted directly from the sources and are found in the atmospheres.
- For Example SO_2 , NO_2 , HC, ash, smoke, dust, mist etc

(2) Secondary pollutants:

- These are formed in the atmosphere by chemical interactions between primary pollutants and atmospheric constituents.
- For Example Ozone, Sulphur trioxide, PAN, aldehydes, ketones etc.

Classification of Air pollutants

B) According to the state of matter

- (1) Gaseous air pollutants
- (2) Particulate air pollutants

(1) Gaseous air pollutants:

- These pollutants are in gaseous state at normal temperature and pressure.
- For Example CO, CO₂, NO_x, SO_x, HC, Photochemical oxidants

(2) Particulate air pollutants:

- These include suspended droplets, solid particles or their mixtures in the atmosphere.
- For Example aerosols, dust, smoke, fumes, mist, fog, flyash, soot, and natural particulates such as pollen grains, protozoa, fungal spores and volcanic dust.

Classification of Air pollutants

(B) According to the state of matter

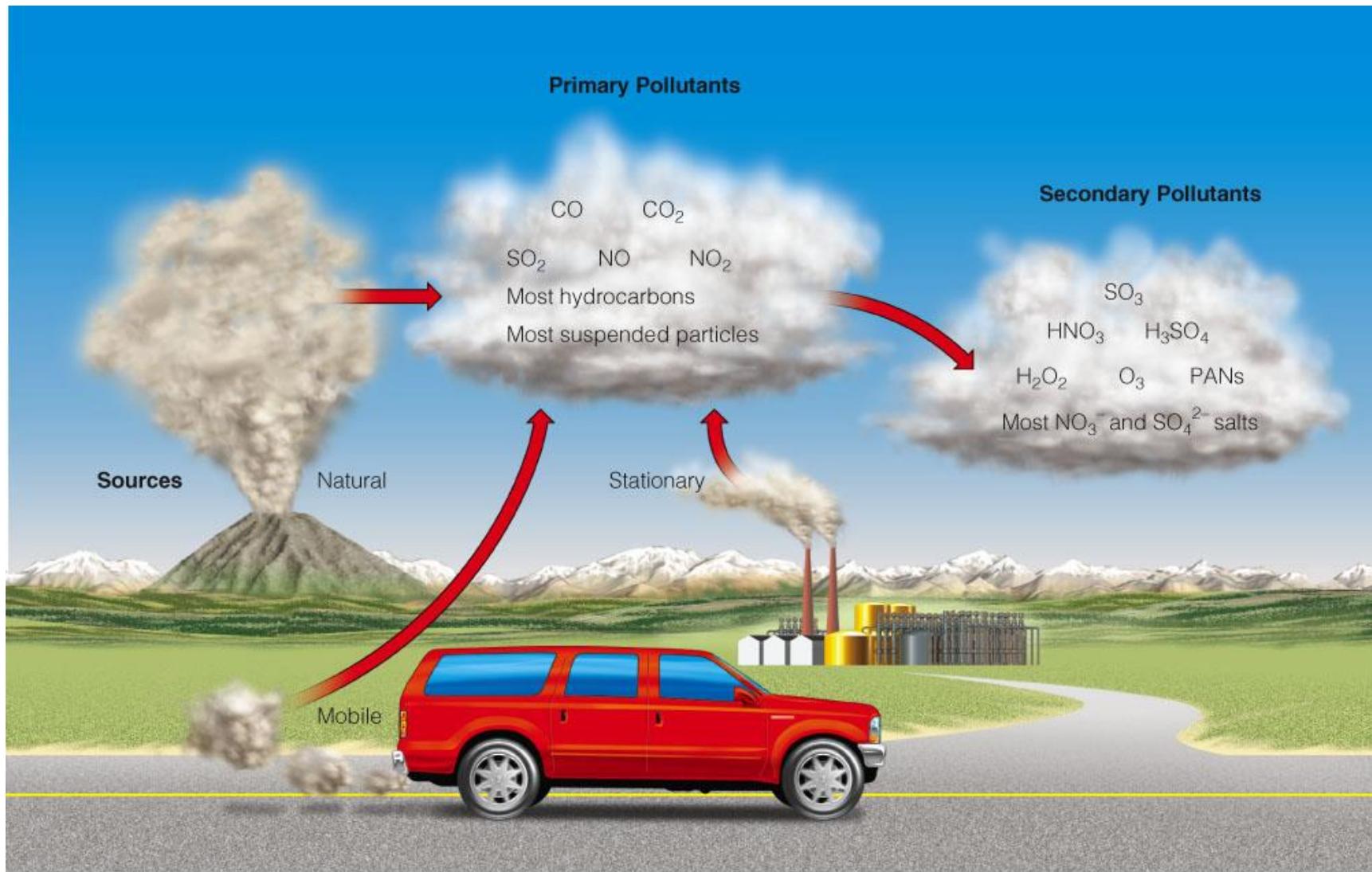
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Air Pollutants- Sources and effect

1. Carbon monoxide (CO)

- It is **colourless, odourless**, tasteless gas.
- It has no effect at normal concentration (0.1 ppm) but at higher conc. It seriously affects the human metabolism.

Sources:

- Volcanic eruption
- natural gas emissions
- electrical discharge during cloud forming
- marsh gas production etc.
- **Transportation sources** contribute about 64% of CO in air.
- Forest fire and agricultural burning contribute about 17 % of in air.

Air Pollutants- Sources and effect

- Industrial processes such as electric furnace and blast furnaces in iron and steel industries
- Petroleum refining
- Paper industry
- Gas manufacture
- Coal mining

Effects:

- It reduces the oxygen carrying capacity of the blood by selectively combining with hemoglobin forming carboxy hemoglobin. This causes giddiness, laziness, and exhaustion.
- It reduces vision and causes cardiovascular disorders.
- CO is a very dangerous asphyxiant and its high levels are fatal to human life.

Air Pollutants- Sources and effect

(2) Carbon dioxide (CO₂):

- The content of carbon dioxide in the air has increased by **approximately 15% during the last century** in spite of the fact that photosynthesizing green plants balance the CO₂ - O₂ ratio to a large extent.

Sources:

- Fossil fuel burning
- Agricultural practices (eg. Deforestation)
- Forestry.

Effects:

- its major effect is on the climate of earth (Green House effect).
- CO₂ is less dangerous than CO and cause nausea and headache.

Air Pollutants- Sources and effect

(3) Oxides of Nitrogen (NO_x):

- Nitric oxide and nitrogen oxide are very important pollutant.
- NO is colourless, odourless gas but is NO_2 reddish brown and have suffocating odour.

Sources:

- Fuel combustion in automobiles and industries.
- Lightening
- Forest fire
- Bacterial decomposition of organic matter

Effects:

- Nitric oxide combine with hemoglobin and reduces the oxygen carrying capacity of blood.

Air Pollutants- Sources and effect

- NO_2 is more toxic than NO and may affect lungs and cause bronchitis.
- NO_2 reacts with atmospheric moisture to form nitric acid causes acid rain and affects vegetables and metals.

(4) Oxides of sulphur (SO_x)

- SO_x include SO_2 and SO_3 .
- SO_2 is colourless gas having pungent and suffocating odour.

Sources:

- most of the SO_x pollution (67%) due to volcanic activities and other natural sources.
- Burning of solid and fossil fuels
- Transportation
- Industries like paper mfg. plants, refineries, sulphuric acid plant
- Open burning of refuse and municipal incinerator

Air Pollutants- Sources and effect

Effects:

- It causes cardiac diseases, asthma, bronchitis, eye irritation, throat troubles etc..
- Long term exposures to high levels of sulphur dioxide gas causes respiratory illness and heart diseases.
- Oxides of sulphur attacks building materials especially marbles and lime stone. (eg. Taj Mahal at agra)
- SO_2 react with moisture in atmosphere to form sulphuric acid which causes acid rain affects vegetables and metals.
- Oxides of sulphur may affect clothes, leather, paper and plants.

(5) Hydrocarbon (HC):

- the gaseous and volatile hydrocarbons are mainly responsible for air pollution.
- Common HC includes methane, ethane, acetylene etc.

Air Pollutants- Sources and effect

Sources:

- Coal fields
- Natural fires
- Incomplete combustion from car engines
- Industrial sources (refineries)
- Forest fires
- Agricultural burning
- Coal waste fires

Effects:

- Some aromatic HC may cause cancer.
- Unburned HC with oxides of nitrogen in the presence of sunlight from Photochemical oxidants (like ozone, PAN) which are harmful.

Air Pollutants- Sources and effect

(6) Photochemical oxidants:

- The major photochemical oxidant is ozone.
- Ozone is produced in the upper atmosphere by solar reaction, small concentrations of this gas diffuse downwards and become the major concern in the air pollution.
- In the presence of sunlight, the oxides of nitrogen react with the unburned HC released by the exhausts of automobiles and following a series of complex reactions produce secondary pollutants like PAN, Ozone, aldehydes and Ketones etc.



Unburnt HC + NO_x

Photochemical smog

Sources:

- Automobile exhausts

Air Pollutants- Sources and effect

Effect:

- Photochemical oxidants cause irritation of eye, nose and throat, headache etc.
- Ozone damage chromosomes.
- Ozone and PAN cause damage to plants by interfering with plant cell metabolism especially in leafy vegetables. Premature fall and yellowing of leaves are due to this pollutant.
- Photochemical oxidants also effect the materials like rubber, plants, textile fibers etc.

(7) Particulate Air pollutants:

- These are small, solid particles and liquid droplets present in the atmosphere in fairly large numbers and sometimes pose serious air pollution problems.
- The size of particulate ranges from 0.02μ to 500μ .

Air Pollutants- Particulate Matter

(1) Aerosols:

- These include all air borne suspensions of solid or liquid particles smaller than 1 mm.

(2) Dust:

- It consist of small solid particles (size 1 to 200 μm) and are generated by material crushing, grinding or blasting.

(3) Smoke:

- it consist of fine solid particles (size 0.1 to 1 μm) resulting from the incomplete combustion of organic particles like coal, wood, tobacco or other chemical processes.

(4) Fumes:

- These are fine solid particles (size 0.1 to 1 μm) formed by the condensation of vapors of solids materials.

(5) Mist:

- It consist of liquid droplets formed by the condensation of vapours in the atmosphere or are released from industrial operation.

Air Pollutants- Particulate Matter

(6) Fog:

- if the mist is made up of water droplets whose concentration is high and dense enough to obscure vision then the mist is called fog.

(7) Flyash:

- This consists of finely divided non combustible particles present in the gases arising from fuel combustion.

(8) Soot:

- Incomplete combustion of carbon containing materials release carbon particles.

Air Pollutants- Particulate Matter

Sources:

- Volcanic eruption
- Dust storms
- Spraying of salts by oceans
- Fly ash from combustion of fossil fuels
- Smoke from vehicles
- Mining
- Agriculture burning

Effect:

- Health effects - Particulates less than $10 \mu\text{m}$ can enter deep into the lungs and may also get into blood streams. It can cause problems like irritation, asthma, chronic bronchitis and other lung diseases.

Air Pollutants- Particulate Matter

- Particulates accelerate corrosion of metals, damages buildings, paints etc.
- Aerosols (Fluorocarbons, NO_x , SO_x) released from emissions from jet and supersonic planes deplete the ozone layer in higher atmosphere.
- Dust coating on leaves affects photosynthesis and reduces plant growth.
- Fly ash reduces pH balance and potability of water.
- Metal dust containing heavy metals and cotton dust may also cause respiratory problem.

Effects of Air Pollution on Human Health

- Carbon monoxide (CO) and nitric oxide (NO) combine with hemoglobin to form carboxy hemoglobin (COHb) which reduces oxygen carrying capacity of blood.
- Oxides of nitrogen (NO_x) and oxides of sulphur (SO_x) cause irritation to eye, throat and nose. They can cause diseases like asthma and bronchitis.
- Pollen can initiate asthmatic attacks.
- Secondary pollutant (O_3 , PAN) produced by hydrocarbons and NO_x , results in the formation of photochemical smog, which causes irritation of eyes, nose, throat and respiratory diseases.
- Some aromatic hydrocarbons may cause cancer.
- Exposure to dust, smoke, smog and soot may include several respiratory diseases like asthma, bronchitis and lung cancer.

Effects of Air Pollution on Human Health

- Heavy metals like lead may cause poisoning effects on nervous system, damage to kidney and vision problem.
- Nickel particulates in tobacco smoke result in respiratory damage.
- Radioactive substances cause lung diseases and affect kidney , liver, brain and sometimes may cause cancer.
- Atmospheric dust containing silica may cause silicosis.

Effects of Air Pollution on plants and vegetation:

- Air pollutants affect plants by entering through stomata (leaf pores through which gases diffuse), destroy chlorophyll and affect photosynthesis.
- Pollutants also erode waxy coating of the leaves called cuticle. Cuticle prevents excessive water loss and damage from diseases, pests, drought and frost. Damage to leaf structure causes dropping of leaves.
- Particulate like dust, fog, soot deposit on plant leaves, block stomata and affect the rate of transpiration.

Effects of Air Pollution on Property / Material:

- SO_2 in the presence of oxygen and moisture is converted into H_2SO_4 acid. Deposition of this acid on metal parts of building roofs, railway tracks, metal on bridges cause corrosion.
- H_2SO_4 acid deposition reacts with limestone, marble and other building materials to cause deterioration and disfigure the building material.
- Pollutants like SO_2 , O_3 , H_2S and aerosols damage protective coating and paints of the surface.
- Damage of textile dyes and textile fibers is caused by SO_x , NO_x and O_3 .
- Ozone and PAN cause cracking of rubber tyres and various forms of electrical insulation.
- Deterioration of lather and paper due to H_2SO_4 decomposition.
- Soiling increases cost of cleaning shirts and other wears, windows, building surface.

Effects of Air pollutants on Climate:

- Due to man made activities like industrialization, automobiles, deforestation etc., concentration of CO₂ and other green house gases in atmosphere will increases.
- About 50% of Green House Effect may be attributing to CO₂, which resulted in the increase in temperature of earth. This increase in temperature caused the melting of ice caps and glaciers. Thus the increase in ambient air temperature will increase the mean sea level.
- The thinning of the ozone layer in the stratosphere by the action of aerosols will increase the penetration of harmful ultraviolet rays to earth and this will cause blindness, Sunburn, inactivation of proteins, RNA and DNA.

Effects of Air pollutants on Aesthetic Beauty:

- The most noticeable effect of air pollution on the properties of atmosphere is the reduction in visibility, which may lead to safety hazard.
- Visibility is reduced by adsorption and scattering of light by air borne particles (0.1 to 1 μm size).
- Industrial and automobiles emissions, sewage and garbage emit foul odours causing further loss of aesthetic beauty.

Factors affecting Air pollutant

The factors which affect air pollution are as follows:

1. Metrological parameters or characteristics:

- Wind direction
- Wind Speed
- Relative Humidity, etc.

2. Topographical features:

- Unevenness of land forms and barriers like mountains valleys.

3. Characteristics of pollutants:

- Type and size of pollutants
- Interaction among pollutants

4. Mode of release of pollutants:

- Intermittent, continuous, cyclic
- From single sources or multiple sources
- From point sources or area sources

Chapter-4

Noise Pollution

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Noise pollution:

Sound and Noise

- **Noise** is unpleasant and unwanted sound.
- **Sound** is what we hear.
- The difference between sound ad noise depends upon the listener and the circumstances.



Unit of Measurement:

Sound powers:

- It is the wound energy transferred per second from the sources (sound) to the air. Power is expressed in watts (W).

Sound Power Level L_w :

- Sound power in watts converted to decibel scale is called the sound power level.

Noise pollution

Sound pressure:

- it is the amount of air pressure fluctuation created by the source of the sound.
- Sound pressure is expressed as Pascal. A healthy young person can hear sound pressure is low pressures as low as 0.00002Pa.

Sound Pressure Level (SPL):

- Sound pressure converted to the decibel scale is called sound pressure level.
- Decibel (dB) is used in environmental noise pollution as a measure of sound power level, sound intensity level and sound pressure level.

Noise pollution

NOISE LEVELS

Once a noise reaches over 85 dB (approximately the level of a vacuum), damage to your hearing may begin.

After this, every 3 dB increase in sound halves the length of time that your ears can handle the noise before damage starts.

You can only listen to personal music players (PMPs) for approximately 3.75 minutes on a high volume before it starts to damage your hearing.

The lower the volume, the longer you can safely listen for.

Decibel Level (Unit of sound measurement)	How long can you listen without protection?	Noise Source
130	0	Jet take off
120	0	Music concert
115	Less than 1 minute	Sports event
109	Less than 2 minutes	Car horn
106	3.75 minutes	Personal music player at maximum volume
103	7.5 minutes	Belt sander
100	15 minutes	School dance, machinery
97	30 minutes	Motorcycle
94	1 hour	Electric drill
91	2 hours	Shouting, lawn mower
Level at which damage begins		
85	8 hours	Vacuum cleaner
55	Safe	Conversation

Noise pollution

Noise rating system:

- A noise may consist of different type of sound (Continuous, intermittent, and impulse with different pressure levels operating for different time intervals).
- The frequency of this sound may very. The combined resultant impact of different sound pressure lasting different periods is worked out by using some statistical measures as L_N and L_{eq} system.

The L_N concept:

- The parameter L_N is a statistical measure indicating how frequently a particular sound level is exceeded.
- The value of L_N will represent the sound pressure level that will exceed for N% of the gauging time.

Noise pollution

The L_{eq} concept:

- L_{eq} is defined as the constant noise level, which over a given time, expands the same amount of energy, as is expanded by fluctuating levels over the same time.

Sources of Noise Pollution

Following are the main sources of noise pollution

- Traffic sources
- Industrial sources
- Constructional sources
- Other miscellaneous sources

1. Traffic sources:

- noise created by various means of transport like trucks, tractors, buses, trains, aeroplanes, etc are the traffic related source of noise pollution.

Noise pollution

It may be in the form of:

- Horn of vehicles
- Vehicle with damaged silencer
- Noise produced by a diesel car will be more than that produced by a petrol car.
- A jet aircraft will produce more noise than a propeller type of aircraft.

2. Industrial sources

- Noise is the essential by product of industry, its intensity and nature being dependent upon the type of industry.

Industrial noises are usually produced by:

- Reciprocating or rotating machinery
- Cutting of materials, grinding
- Blow hammers
- Generators

Noise pollution

3. Constructional sources

- Noises produced by various constructional activities are:
- Rock crusher for production of aggregate
- Pile driving equipment
- Boring and drilling equipment
- Road rollers
- Materials handling by conveyers
- Rock blasting

4. Other miscellaneous sources

- **In residential area** – Loud voice of T.V., music systems, radio, etc
- **Public address system** – public functions, Navratri festival etc.
- **Sirens** – Police van, industries, ambulance
- **Military sources** – noise of bomb, grenade explosion, tanks other vehicles, missiles etc.

Noise pollution

Noise pollution effects:

Major effects:

1. Loss of hearing
2. Annoyance
3. Health effects
4. Interference with communication
5. Working efficiency

1. Loss of hearing:

- Loss of hearing occur due to exposure of noise, which is termed as artificial hearing loss. This loss is divided into two types:

A. Noise Induced Temporary Threshold Shifts (NITTS):

- This is caused due to exposure to loud noise like bursting of crackers. This can be recovered in a short period of time.

B. Noise Induced Permanent Threshold Shifts (NIPTS):

- This occurs because of exposure to loud noise for a long period of time.

Noise pollution

2. Annoyance:

- This is a subjective matter for a noise. Someone may like classical music, it may annoy other.
- Blood vessels get constricted, breathing rate is affected and musical tension changes.

3. Health effects:

(i) Effects on physical health:

Auditory effects:

- They are grouped into short time and long time effects.
- Acoustic trauma is caused by a very high intensity impulsive noise of about 150 db or more from explosion.

Non – auditory effects:

- Exposure to a loud noise may increase the pulse rate and blood pressure changes. Body experiences fear reactions. Disturbed brain waves lead to the interference in vision.

(ii) Effects on mental health:

- Effect on mental health is less. Lack of concentration at high noise level.

Noise pollution

4. Interference with communication:

- A person may face the problem of trying to understand another person talking to him/her in an environment with high background noise level.

5. Working efficiency:

- It is found to be decreased drastically whenever a person is working in the noisy environment

Other effect:

- Sleep interference
- Increased industrial accidents
- Personal comfort interference
- Property value degradation
- Effects on wildlife

Noise pollution

Control of Noise Pollution:

1. Proper maintenance and lubrication of machine can reduce noise.
2. Sources of noise pollution like heavy vehicles, airports, noise producing industries etc should be located away from populated areas.
3. Silence zones should be created around residential areas, educational institutions and hospitals.
4. Noisy machines should be installed in sound proof chamber.
5. Planting more trees having broad leaves which can absorb sound.
6. Use of loud-speakers and amplifiers should be restricted to a fixed intensity and fixed hours of the day.
7. Occupational exposure to noise can be reduced by using protective devices such as ear plugs.
8. Restricting the unnecessary horn blowing by laws.

Chapter-5

Solid waste: Generation and Management

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Topics to be covered

- Definition and Important terms.
- Types and Sources of Solid Wastes.
- Generation rates of Solid waste.
- Causes of Solid waste pollution.
- Effects of Solid waste Pollution.
- Solid waste management.

Definition:-

- **Garbage**:- All types of putrescible organic wastes obtained from kitchen, hotels, restaurants in form of waste food etc., in form of waste food articles, peeling of vegetables, fruits etc. It also includes animal dung, grass and leaves etc.
- **Rubbish**:- All non putrescible wastes except ashes are known as rubbish. It includes rags paper pieces of glass, paper packets, glass and plastic bottles, broken crockery etc.
- **Ashes**:- Ashes are incombustible waste products obtained from, industries, hearth and furnaces.
- **Putrefaction**:- Microbial decomposition of organic matter accompanied by odour is called putrefaction.
- **Leachate**:- Liquid that has travelled through solid waste or other medium and has extracted, dissolved or suspended materials from it is called leachate.

Types and Sources of Solid waste:

- **Municipal waste**:-Municipal waste are those waste which arise from house hold activities, public places, restaurants, institution markets street-sweeping etc.
- **Industrial wastes**:- Industrial wastes are that waste which arises from industrial activities. It typically includes rubbishes, ashes demolition and construction waste, special waste and hazardous waste.



Types and Sources of Solid waste:

- **Hazardous waste:-** Wastes that poses a substantial danger immediately or over a period of time to human animal or plant life are called hazardous wastes.



Causes of Solid waste pollution

- 1. Over population:-** As the number of people producing pollutant increase, pollution will naturally increase. Same is true for solid waste pollution too. Solid waste pollution increase with increase in population.

- 2. Technology:-** rapidly growing technology fro most economic goods indicates a shift in technology from the returnable packaging to non-returnable packaging.

Causes of Solid waste pollution

3. Urbanization:- Solid waste is preliminary as urban problem, though not exclusively urban. Solid waste pollution increases with increase in urbanization.

4. Affluence:- With increase in the affluences there is a tendency to declare items as being in or out fashion and promptly throw away the ones which are out of fashion. This results in solid waste pollution

Effects of solid waste pollution:-

- Transmission of many disease due to flies breed on the refuse/solid waste dumps.
- Rats flourishing upon the solid wastes may also cause the diseases.
- Improper disposal can cause contamination of crops and water supply.
- Obnoxious order arising from decomposing solid waste can call air pollution and causing problems in the surrounding areas.
- Solid waste dump also creates aesthetically unpleasing surrounding environment.

Solid Waste Management

- The solid waste management has the following components:
- Identification of waste and its minimization at the source
- Collection, segregation and storage at the site of collection
- Transportation
- Treatment
- Energy recovery
- Disposal

Collection of Solid waste:-

- **Kerbside collection:** The house owner is responsible for placing the solid waste containers at the curb on the scheduled day. The workmen come, collect and empty the container and put back at the curb. The house owner is required to take back the empty containers from the curb to his house.
- **Block collection:-** Individuals bring the waste in containers and hand it over to the collection staff who empties it into the waiting vehicles and return the container to the individuals.
- **Community Storage point:-** The solid waste is taken to a fixed storage bins and stored till the waste storage agency collect it as per the schedule of the collection.

Processing of Solid Waste

- Processing techniques are used in solid waste management systems to (1) improve the efficiency of solid-Waste disposal systems (2) To recover Resources and (3) To prepare materials for the recovery of conversion products and energy.

Disposal of Solid waste:-

- Disposal on or in the earth's mantle is, at present the only viable method for long-term handling:
 - (1) Solid Wastes that are collected and are of no further use,
 - (2) The residual matter remaining after solid wastes have been processed,
 - (3) The residual matter remaining after the recovery of conversion products and energy has been accomplished.
- Landfilling is the method of disposal used most commonly for municipal wastes; land farming and deep-well injection have been used for industrial wastes. Although incineration is often considered a disposal method, it is in reality, a processing method.

Disposal of Solid waste:-

1. open dumping
2. Sanitary Land filling
3. Incineration
4. Composting
5. Pyrolysis

▪ **Open dumping**:- In this method the solid waste is dumped in to low lying areas and outskirts of the cities. Being relative cheaper.



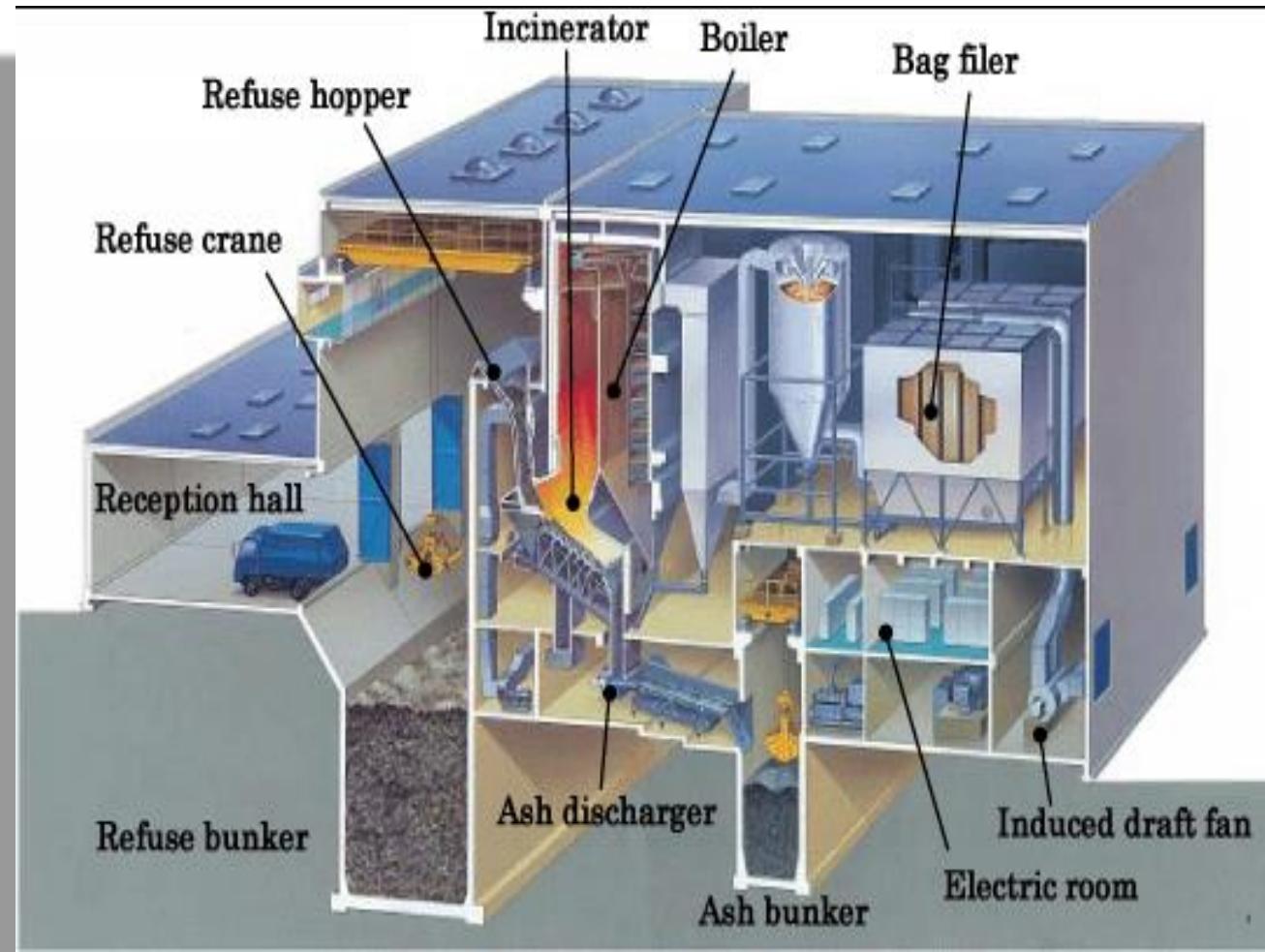
Disposal of Solid waste:-

- **Sanitary landfill**:- in this method the solid waste is disposed or dumped either in naturally available low lying area or digging tranches or in open areas under an engineered operation, design and operated according to the acceptable standards not causing any nuisance or hazard to the public health or safety.



Disposal of Solid waste:-

- Incineration:-



Disposal of Solid waste:-

- Incineration can be defined as a controlled combustion process for burning solid, liquid and gaseous combustible wastes to gases and residue containing non combustible material.
- Incinerators are used for the process of incineration. Following important points should be observed carefully during incineration.
- Charging of solid waste should be continuous.

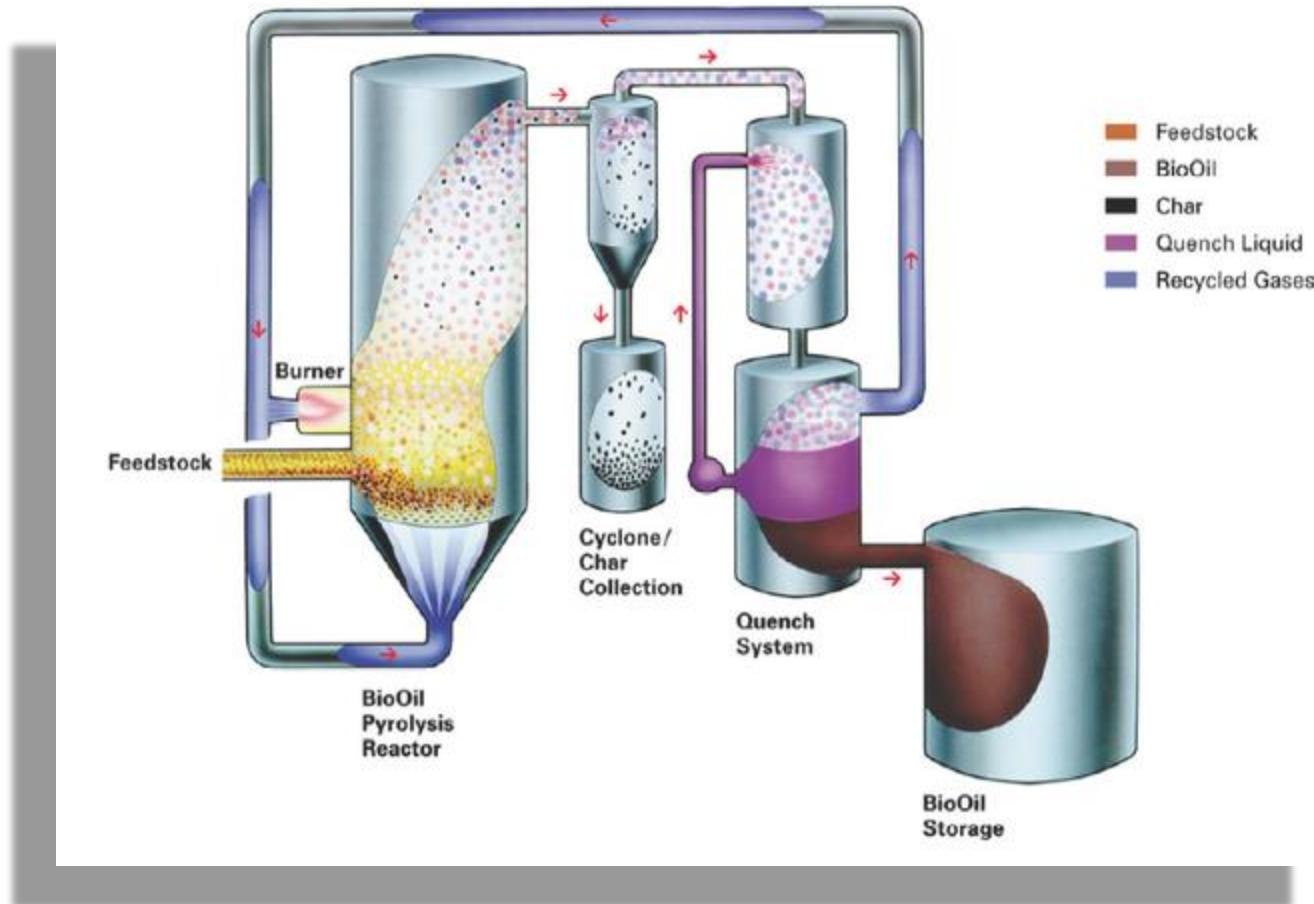
Disposal of Solid waste:-

- Composting as defined earlier is a process in which organic matter of the solid waste is decomposed and converted to humus and stable mineral compounds. The end product of composting process is called compost which is rich fertilizer.
- There are three methods of composting:
- (1) Composting by Trenching
- (2) Open window composting
- (3) Mechanical Composting

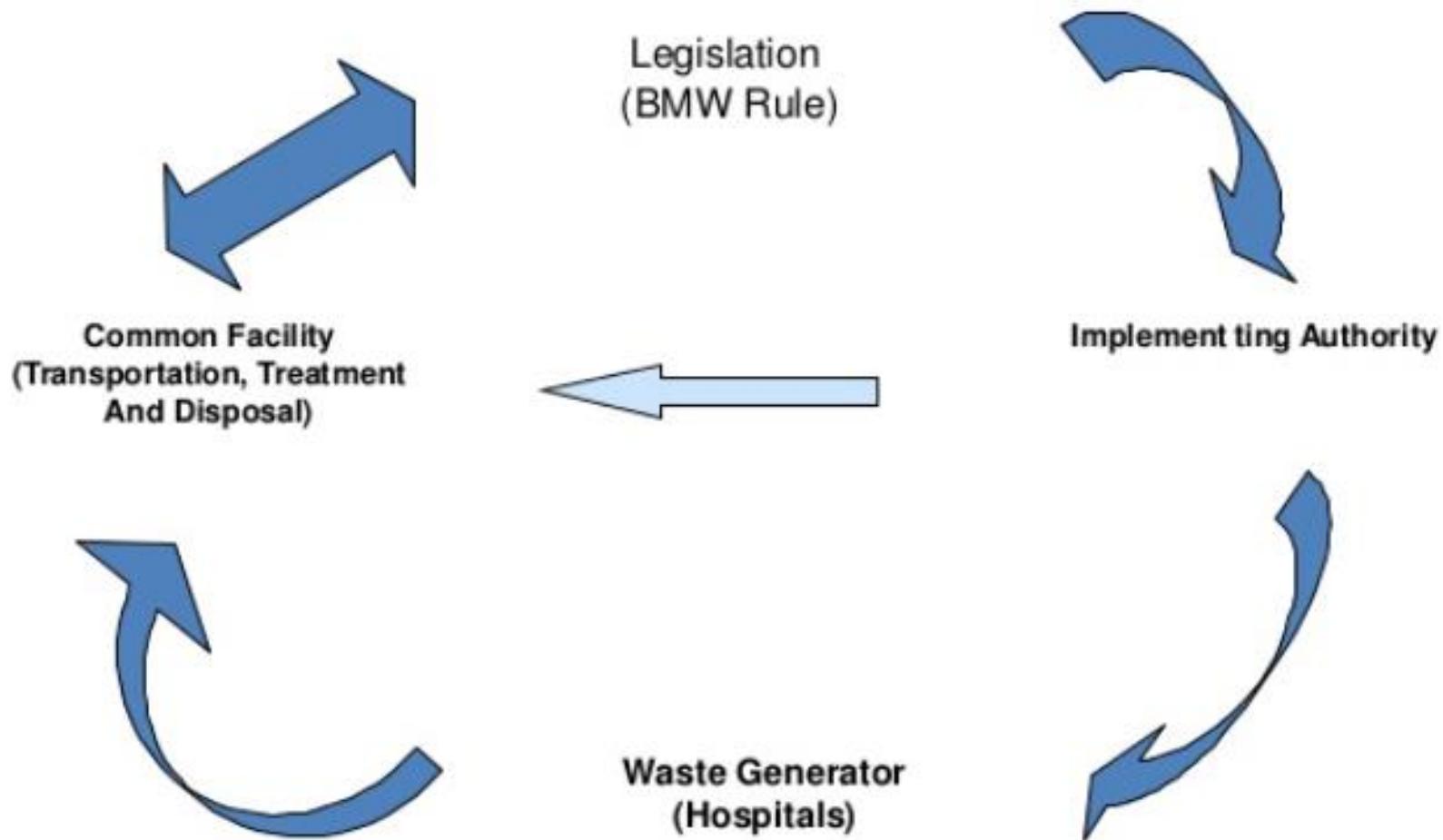
Disposal of Solid waste:-

- **Pyrolysis:**
- It is defined as heating the solid waste at very high temperature in absence of air.
- Pyrolysis is carried out at a temperature between 500°C to 1000°C to produce three component streams.
- Gas: It is a mixture of combustible gases such as hydrogen, carbon dioxide, methane, carbon mono-oxide and some hydrocarbons.
- Liquid: It contains tar, pitch, light oil, and low boiling organic chemicals like acetic acid, acetone, methanol etc.
- Char: It consists of elemental carbon along with inert material in the waste feed.
- The char liquid and gases have high calorific values.
- It has been observed that even after supplying the heat necessary for pyrolysis, certain amount of excess heat still remains which can be commercially exploited.

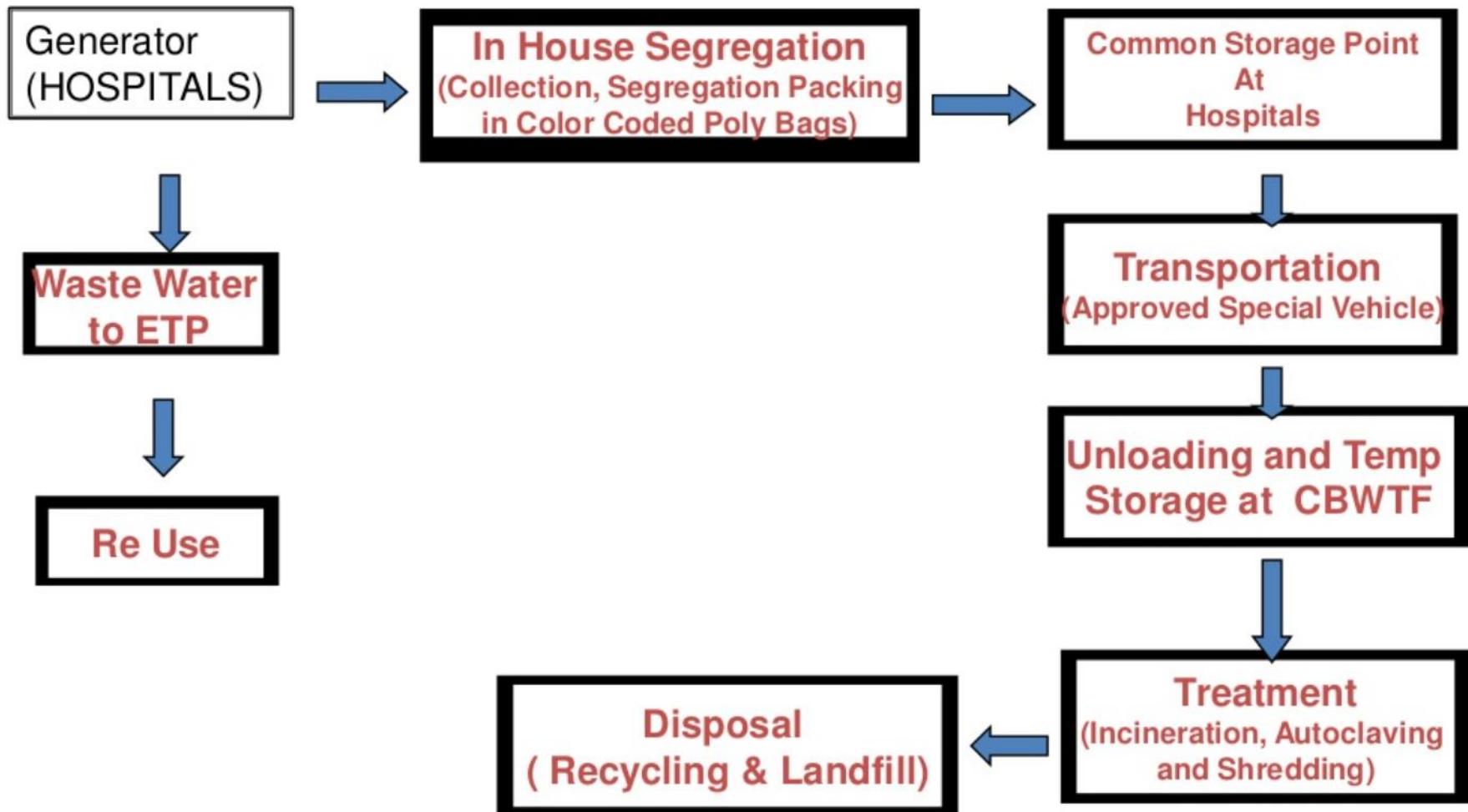
Disposal of Solid waste:-



Bio-Medical Waste Disposal Cycle



Bio-Medical Waste Flow Chart



COLOR	WASTE	TREAT
Yellow	Human & Animal anatomical waste / Micro-biology waste and soiled cotton/dressings/linen/beddings etc.	Incineration/DB/
Red	Tubings, Catheters, IV sets.	Autocl/microwave/chemical treatment
Blue / White	Waste sharps (Needles, Syringes, Scalpels, blades etc.)	Autocl/microwave/chemical treatment/destruction/shredding
Black	Discarded medicines/cytotoxic drugs, Incineration ash, Chemical waste.	Disposal in land fields

Chapter-7

E-Waste: Generation and Management

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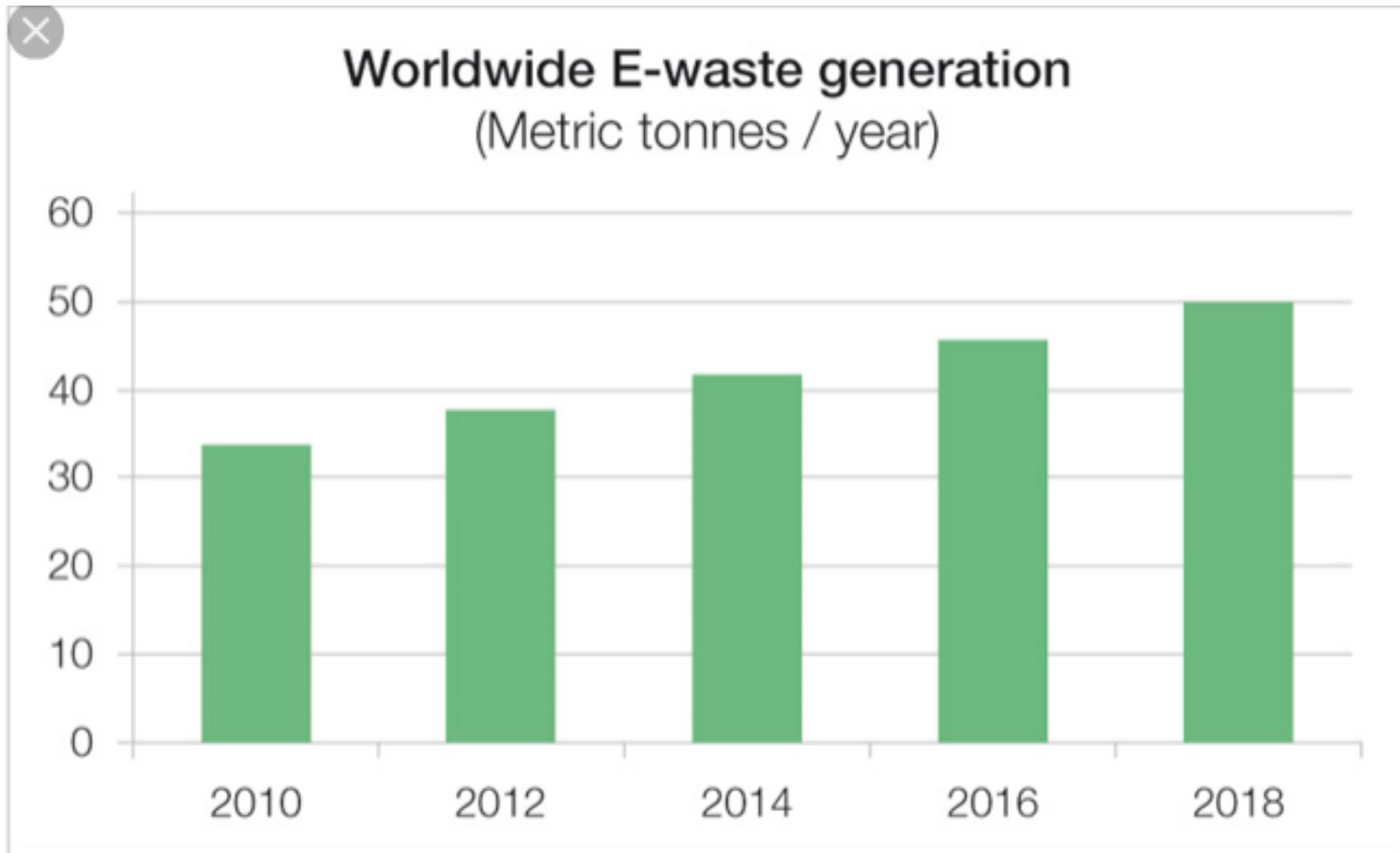
Introduction

- E-Waste is defined as electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing refurbishment and repair process.

Classification of E-Waste

- Large house hold appliances.
- Small household appliances.
- Information technology and telecommunication equipment.
- Consumer equipment
- Lighting equipment.
- Medical equipment system
- Monitoring and control instrumentation
- Automatic dispensers.

Generation of E-waste:-



Generation of E-waste:-

These Countries Generate the Most Electronic Waste

Top 10 countries by the amount of e-waste generated in 2016*



* includes discarded products with a battery or plug including mobile phones, laptops, televisions, refrigerators, electrical toys and other electronic equipment

Source: The Global E-waste Monitor 2017

Impact of E-waste On Environment and Human Health

- E-waste has come under attack in recent years due to its negative effects on the environment and human health.
- E-waste is often considered an overlooked epidemic, as the long-term impact of this waste is still unclear.
- Still, many e-waste recycling centers have been created in recent years in an effort to protect humans and the planet.

Impact of E-waste On Environment and Human Health

1. E-waste Negatively Impacts the Soil

- First, e-waste can have a damaging effect on the soil of a region. As e-waste breaks down, it releases toxic heavy metals. Such heavy metals include lead, arsenic, and cadmium.
- When these toxins leach into the soil, they influence the plants and trees that are growing from this soil.
- Thus, these toxins can enter the human food supply, which can lead to birth defects as well as a number of other health complications.

Impact of E-waste On Environment and Human Health

2. E-waste Negatively Impacts the Water

- E-waste that is improperly disposed of by residents or businesses also leads to toxins entering groundwater.
- This groundwater is what underlies many surface streams, ponds, and lakes. Many animals rely on these channels of water for nourishment. Thus, these toxins can make these animals sick and cause imbalances in the planetary ecosystem.
- E-waste can also impact humans that rely on this water. Toxins like lead, barium, mercury, and lithium are also considered carcinogenic.

Impact of E-waste On Environment and Human Health

3. E-waste Negatively Impacts the Air

- When e-waste is disposed of at the landfill, it's usually burned by incinerators on site.
- This process can release hydrocarbons in the atmosphere, which pollutes the air that many animals and humans rely on.
- Furthermore, these hydrocarbons can contribute to the greenhouse gas effect, which many scientists think is a leading contributor to global warming.
- In some parts of the world, desperate people sift through landfills in order to salvage e-waste for money. Yet, some of these people burn unwanted parts like wires in order to extract copper, which can lead to air pollution as well.

Management of E-waste

E-WASTE MANAGEMENT



530 x 379

Management of E-waste



720 x 362

Environmental Global Issues

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Introduction

Introduction

- Environmental issues are harmful effects of human activity on the biophysical environment. Environmental protection is a practice of protecting the natural environment on individual, organizational or governmental levels, for the benefit of both the environment and humans



Acid Rain

Acid Rain

- Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions (low pH).
- It can have harmful effects on plants, aquatic animals and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids.
- Acid rain has been shown to have adverse impacts on forests, freshwaters and soils, killing insect and aquatic life-forms, causing paint to peel, corrosion of steel structures such as bridges, and weathering of stone buildings and statues as well as having impacts on human health.

Acid Rain



Dead trees line a riverbank near Norilsk, Russia, formerly a major industrial center in Siberia, and one of the most polluted cities in the world, according to National Geographic.

Credit: Sergei Drozd/Shutterstock

Acid Rain



Depletion of the ozone layer

Depletion of ozone layer

- **Ozone depletion** consists of two related events observed since the late 1970s: a steady lowering of about four percent in the total amount of ozone in Earth's atmosphere (the ozone layer), and a much larger springtime decrease in stratospheric ozone around Earth's polar regions.
- The latter phenomenon is referred to as the **ozone hole**. There are also springtime polar tropospheric ozone depletion events in addition to these stratospheric events.

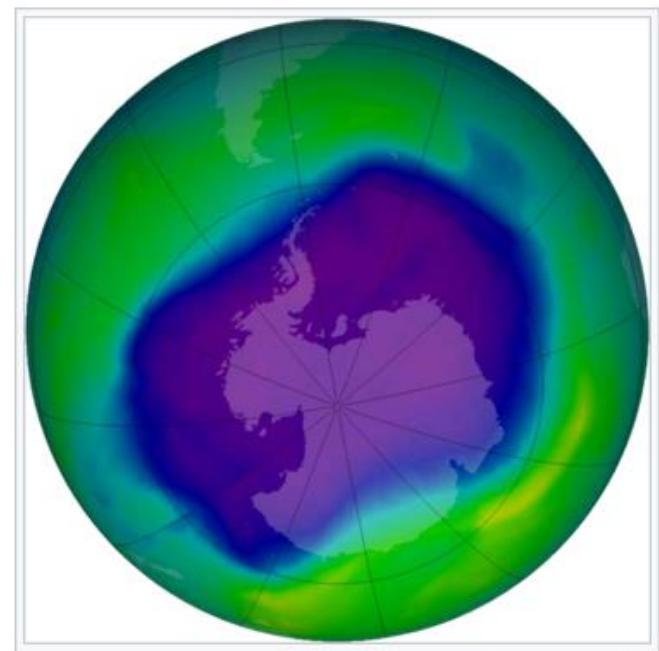
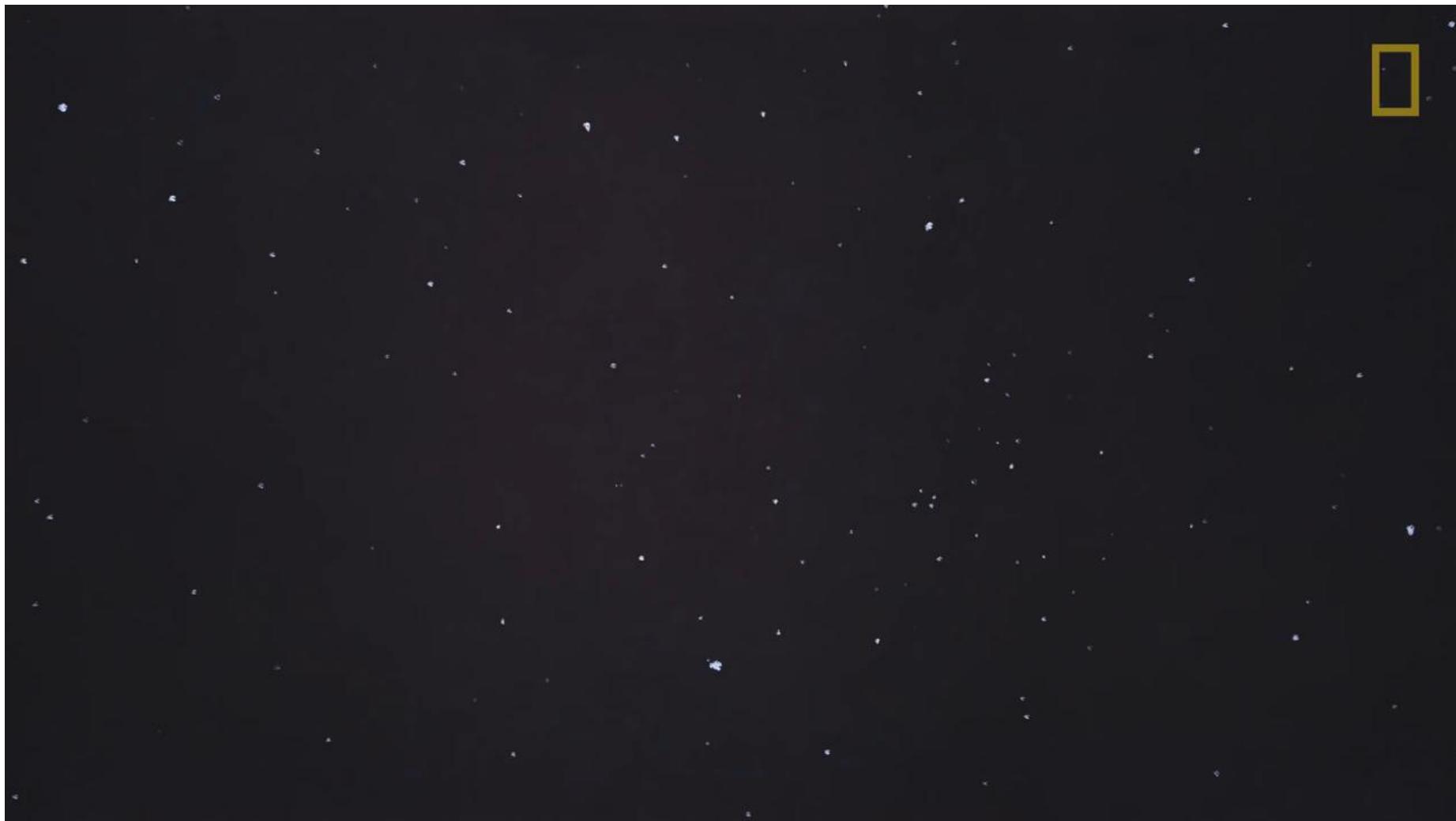


Image of the largest Antarctic ozone hole ever recorded over the South Pole in September 2006

Depletion of ozone layer



Green House Effects

Green House Effects

- The **greenhouse effect** is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without this atmosphere.
- Radiative active gases (i.e., greenhouse gases) in a planet's atmosphere radiate energy in all directions. Part of this radiation is directed towards the surface, warming it.
- The intensity of the downward radiation – that is, the strength of the greenhouse effect – will depend on the atmosphere's temperature and on the amount of greenhouse gases that the atmosphere contains.

Green House Effects

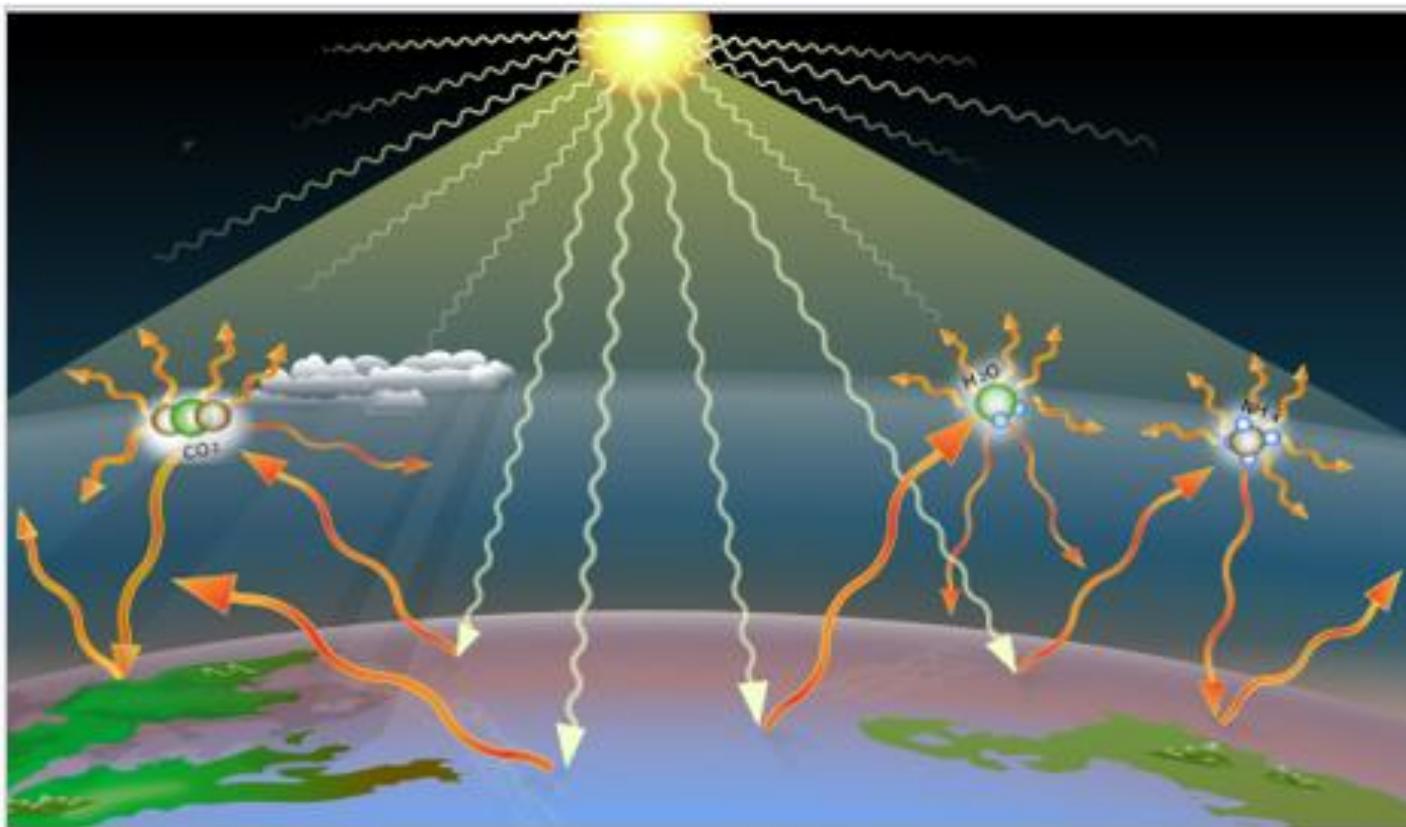
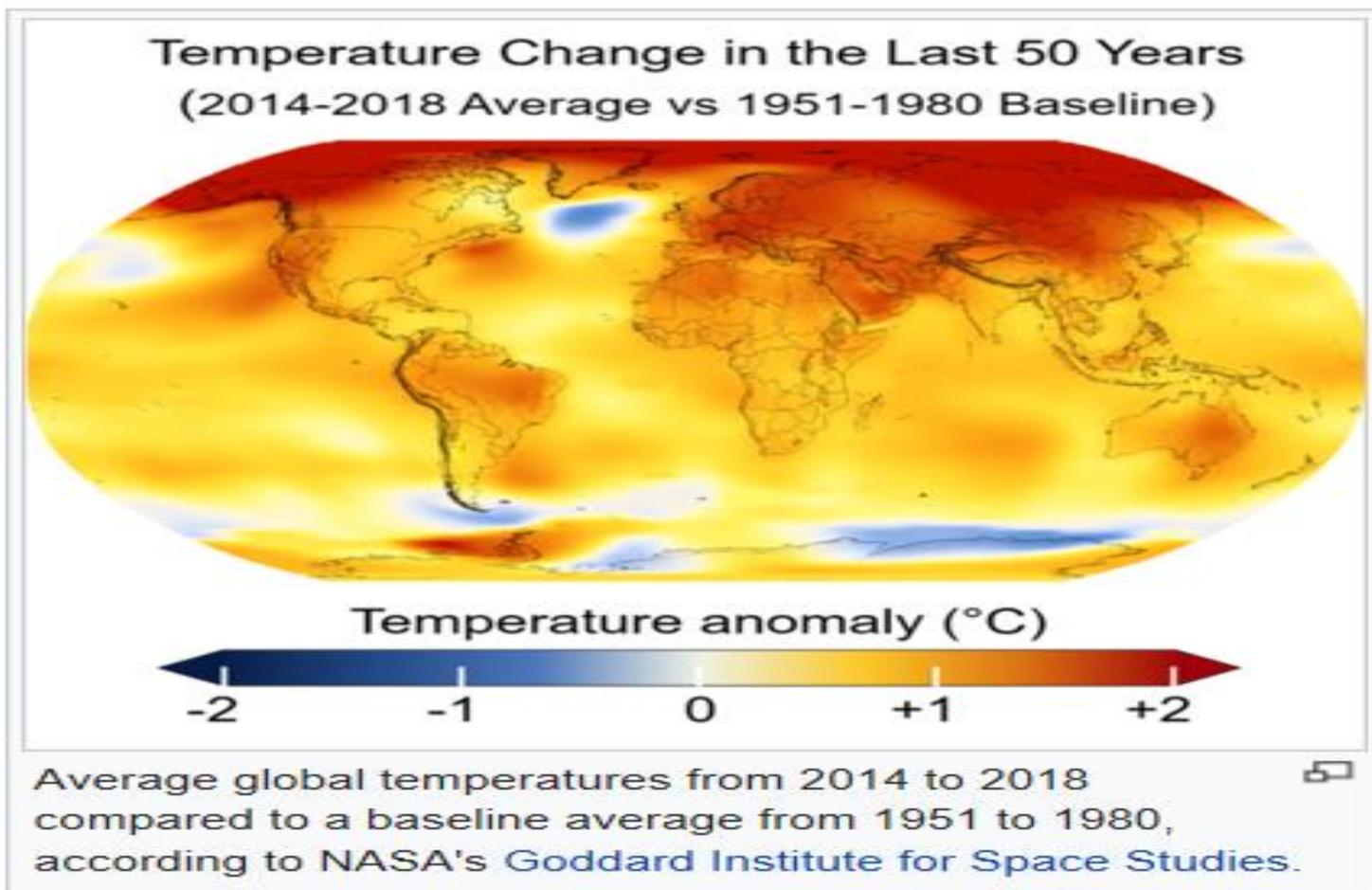


Diagram showing light energy (white arrows) emitted by the sun, reflecting off the earth's surface as heat (orange arrows), and then being remitted as heat by three greenhouse gas molecules (water, carbon dioxide, and methane)

Global Warming

- **Global warming** is a long-term rise in the average temperature of the Earth's climate system; an aspect of climate change shown by temperature measurements and by multiple effects of the warming.
- In the modern context the terms *global warming* and *climate change* are commonly used interchangeably, but *climate change* includes both *global warming* and its effects, such as changes to precipitation and impacts that differ by region.
- Many of the observed changes in climate since the 1950s are unprecedented in the instrumental temperature record, and in historical and paleoclimate proxy records of climate change over thousands to millions of years.

Global Warming



Chapter-9

Green Building and Smart Cities

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Introduction

- A green building is an environmentally sustainable building, designed, constructed and operated to minimize the total environmental impacts.



Objectives

- To minimize the use of energy
- To reduce waste, pollution and environmental degradation
- To provide mechanical ventilation system to increase air flow.
- To select proper building material that has low toxicity
- To enhance interior lighting to reduce energy demand and to increase visual comfort.

Fundamental principles

- Sustainable site design:
- Energy Efficiency
- Water efficiency
- Material efficiency

- **STRUCTURE EFFICIENCY:**

- It is the concept of sustainable building and has largest impact on cost and performance.
- It aims to minimize the environment impact associated with all life-cycles.



- **ENERGY EFFICIENCY:**

- The layout of the construction can be strategised so that natural light pours for additional warmth.
- Shading the roof with trees offers an eco-friendly alternative to air conditioning.

- **WATER EFFICIENCY:**

- To minimize water consumption one should aim to use the water which has been collected, used, purified and reused.



• **MATERIAL EFFICIENCY:**

- Materials should be used that can be recycled and can generate surplus amount of energy.
- An example of this are solar power panels, not only they provide lighting but they are also a useful energy source.



• **WASTE AND REDUCTION:**

- It is possible to reuse resources.
- What may be waste to us may have another benefit to something else.

INDIAN GREEN BUILDING

COUNCIL

- The Indian Green Building Council (IGBC) was formed in the year 2001 by Confederation of Indian Industry (CII).
- The aim of the council is to bring green building movement in India and facilitate India to become one of the global leaders in green buildings by 2015.



GREEN BUILDINGS PROJECT IN INDIA

- Suzlon Energy Limited-Pune
- Biodiversity Conservation India-Bangalore
- Olympia Technology Park-Chennai
- ITC Green Centre-Gurgaon
- The Druk White Lotus School-Ladakh
- Doon School-Dehradun
- Raintree Hotels-Chennai
- Nokia-Gurgaon
- Rajiv Gandhi International Airport-Hyderabad
- Hiranandini-BG House, Powai
- ABN Amro Bank, Chennai
- Palais Royale at Worli, Mumbai
- Punjab Forest Complex,Mohali



Chapter-10

Concepts of 4R'S

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Concept 4R'S

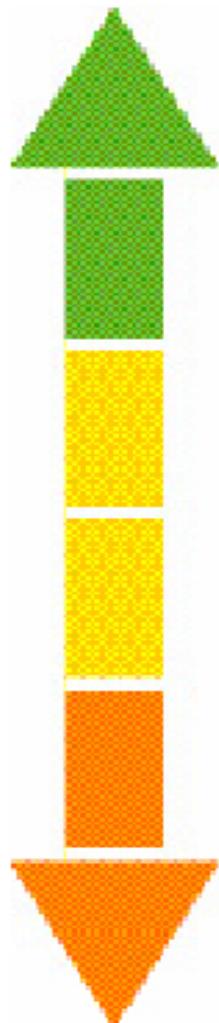
- Reduce
- Reuse
- Recycle
- Recover



Concept 4R'S

- **REDUCE** is to limit the amount of waste you create in the first place. This includes buying products with less packaging.
- **REUSE** means to use something again that you would normally throw away (eg. Glass jar for food or plastic bags for bin liners.)
- **RECYCLE** means the product goes through a mechanical process to change its form. This is only recommended when reducing and reusing are not possible.
- **RECOVER** is to convert waste into resources (such as electricity, heat, compost and fuel) through thermal and biological means. Resource Recovery occurs after reduce, reuse and recycle have been attempted.

most favoured option



least favoured option

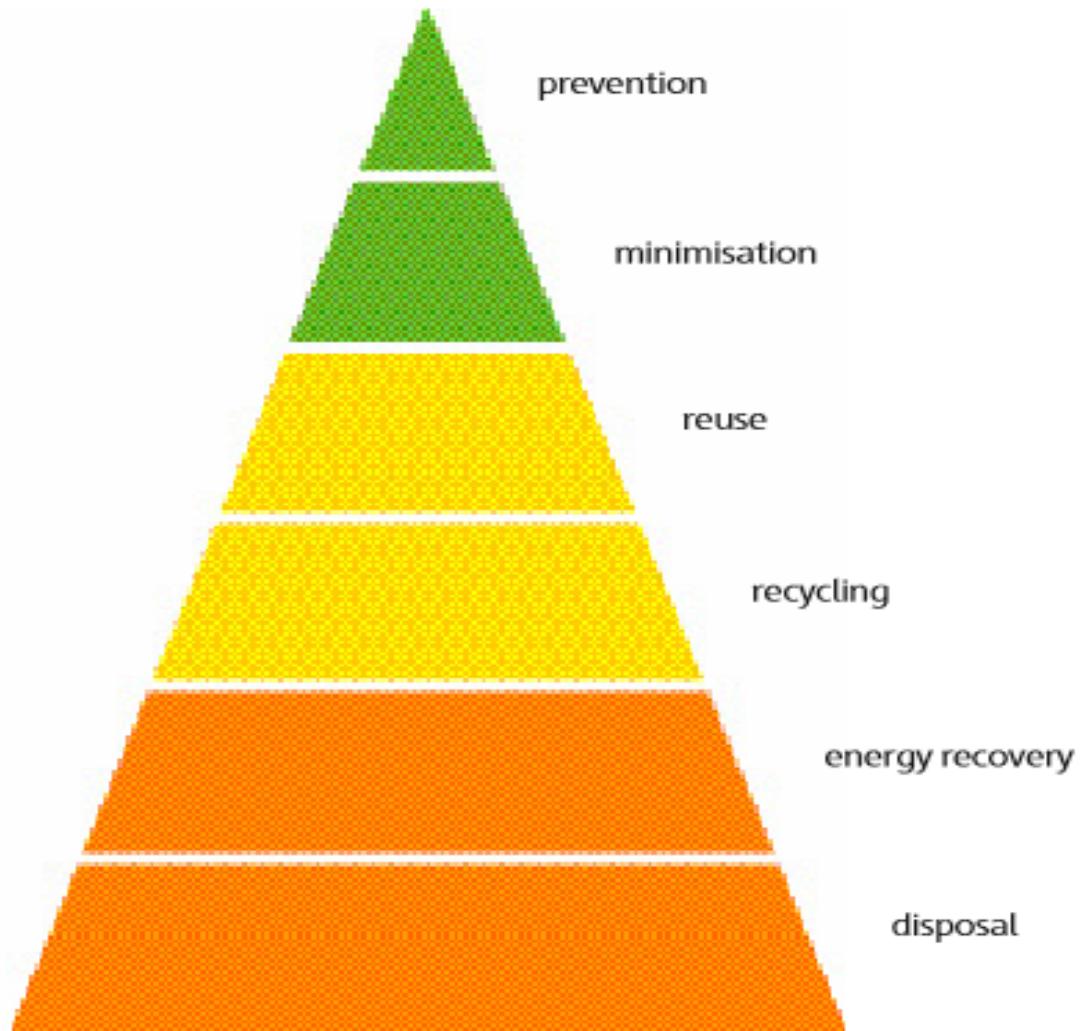


Table 10.1 : Examples showing applicability of 4R for different types of waste

Type of Waste	Examples of Waste	4R Best Practice
Construction Waste	Concrete	Reuse
	Plaster board/Gypsum	Recycle
	Paper	Recycle
	Metal	Recycle
	Excavated material	Reuse
Office Waste	Paper	Recycle
	Cardboard	Recycle
	Hard and soft Plastics	Recycle or Recover
	Toners	Recycle
Waste from manufacturing plants	Asphalt	Reuse
	Concrete	Reuse or Recycle
Demolition waste	Concrete	Reuse
	Steel	Recycle
	Cabling	Recycle or Reuse
	Glass	Recycle
	Timber	Reuse or Recycle
	Other Materials	Reuse or Recycle
	Food and other organic waste	Recycle
Domestic waste	Paper	Reuse
	Plastic	Reuse