INTRODUCTION

ENVIRONMENT

The term environment refers to ones surroundings.

The physical and biological factors along with their chemical interactions that affect an organism or a group of organisms.

The **environment** is the biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence in their survival, development and evolution. The environment can vary in scale from microscopic to global in extent. Examples include the marine environment, the atmospheric environment and the terrestrial environment.

The sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damage.

ENVIRONMENTAL SEGMENTS

The environment consists of various segments such as atmosphere, hydrosphere, lithosphere and biosphere.

Atmosphere

The following points highlight the vital role played by atmosphere in the survival of life in this planet.

• The atmosphere is the protective blanket of gases which is surrounding the earth. It protects the earth from the hostile environment of outer space.

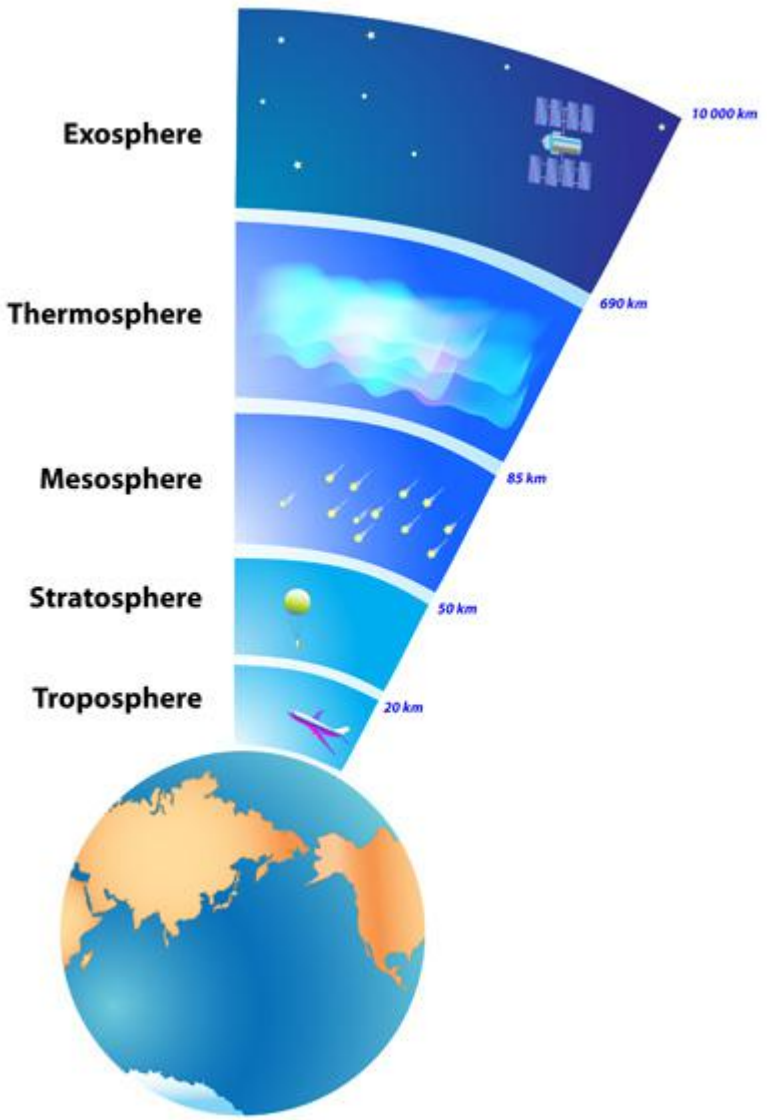
• It absorbs IR radiations emitted by the sun and reemitted from the earth and thus controls the temperature of the earth.

• It allows transmission of significant amounts of radiation only in the regions of 300 – 2500 nm (near UV, Visible, and near IR) and 0.01 – 40 meters (radio waves). i.e it filters tissue damaging UV radiation below 300 nm.

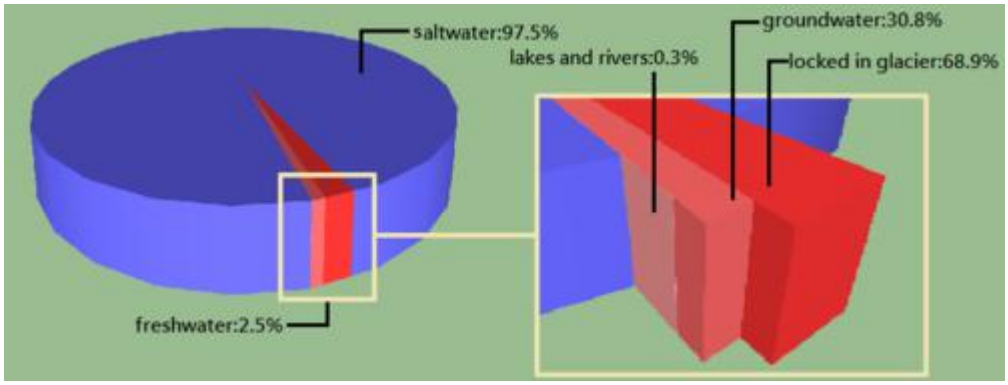
• It acts as a source for CO_2 for plant photosynthesis and O_2 for respiration

• It acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.

• The atmosphere transports water from ocean to land.


Exosphere
10 000 km
Thermosphere
690 km
Mesosphere
85 km
Stratosphere
50 km
Troposphere
20 km

Hydrosphere



The hydrosphere is a collective term given to all different forms of water.

It includes all types of water resources such as oceans, seas, rivers, lakes, streams, reservoirs, glaciers and ground waters.

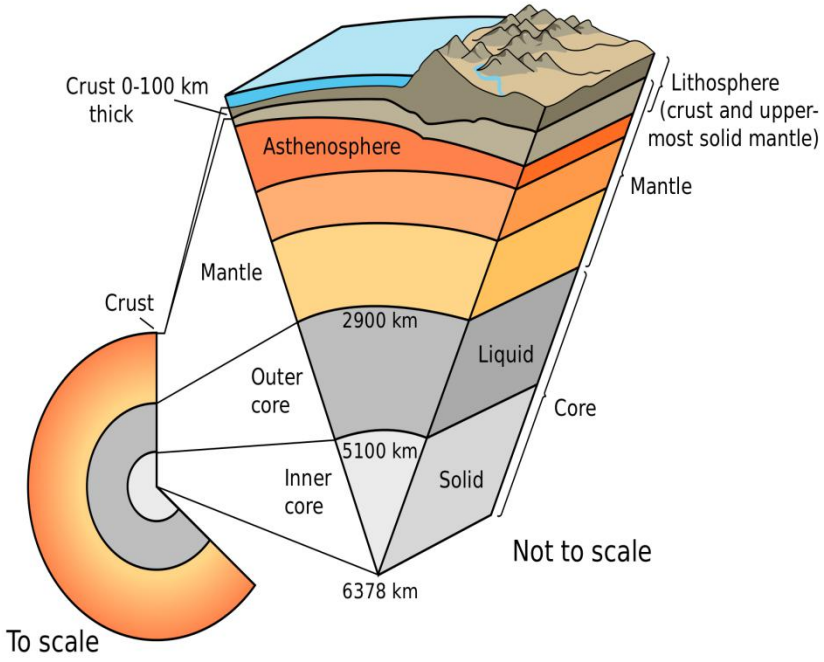
A hydrosphere is the total amount of water on a planet. The hydrosphere includes water that is on the surface of the planet, underground, and in the air. A planet's hydrosphere can be liquid, vapor,or ice.

On Earth, liquid water exists on the surface in the form of oceans, lakes and rivers. It also exists below ground—as groundwater, in wells and aquifers. Water vapor is most visible as clouds and fog.

The frozen part of Earth's hydrosphere is made of ice: glaciers, ice caps and icebergs. The frozen part of the hydrosphere has its own name, the cryosphere.

Water moves through the hydrosphere in a cycle. Water collects in clouds, then falls to Earth in the form of rain or snow. This water collects in rivers, lakes and oceans. Then it evaporates into the atmosphere to start the cycle all over again. This is called the water cycle.

Lithosphere



The lithosphere is the solid, outer part of the Earth.
The lithosphere includes the brittle upper portion of the mantle and the crust, the outermost layers of Earth's structure. It is bounded by the atmosphere above and the asthenosphere (another part of the upper mantle) below.

The lithosphere is the most rigid of Earth's layers. Although the rocks of the lithosphere are still considered elastic, they are not viscous. The asthenosphere *is* viscous, and the lithosphere-asthenosphere boundary (LAB) is the point where geologists and rheologists—scientists who study the flow of matter—mark the difference in ductility between the two layers of the upper mantle. Ductility measures a solid material's ability to deform or stretch under stress. The lithosphere is far less ductile than the asthenosphere. The elasticity and ductility of the lithosphere depends on temperature, stress, and the curvature of the Earth itself.

The lithosphere is also the coolest of Earth's layers. In fact, some definitions of the lithosphere stress its ability to conduct heat associated with the convection taking place in the plastic mantle below the lithosphere.

Biosphere

• The biosphere refers to the realm of living organisms and their interactions with the environment (VIZ: atmosphere, hydrosphere and lithosphere)

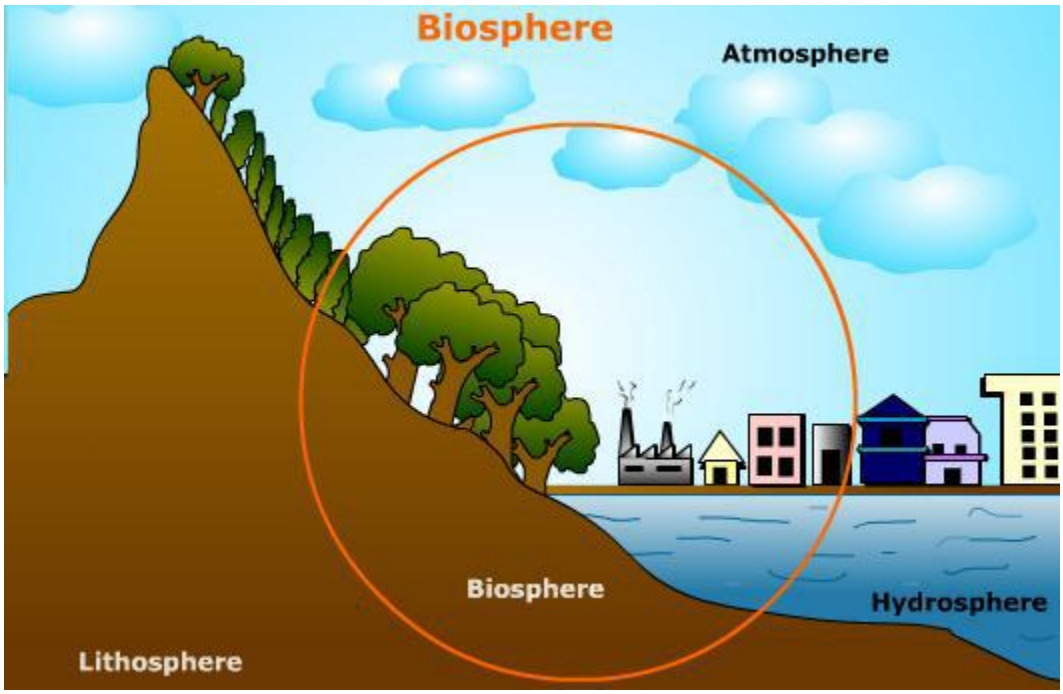
• The biosphere is very large and complex and is divided into smaller units called ecosystems.

• Plants, animals and microorganisms which live in a definite zone along with physical factors such as soil, water and air constitute an ecosystem.

• Within each ecosystems there are dynamic inter relationships between living forms and their physical environment

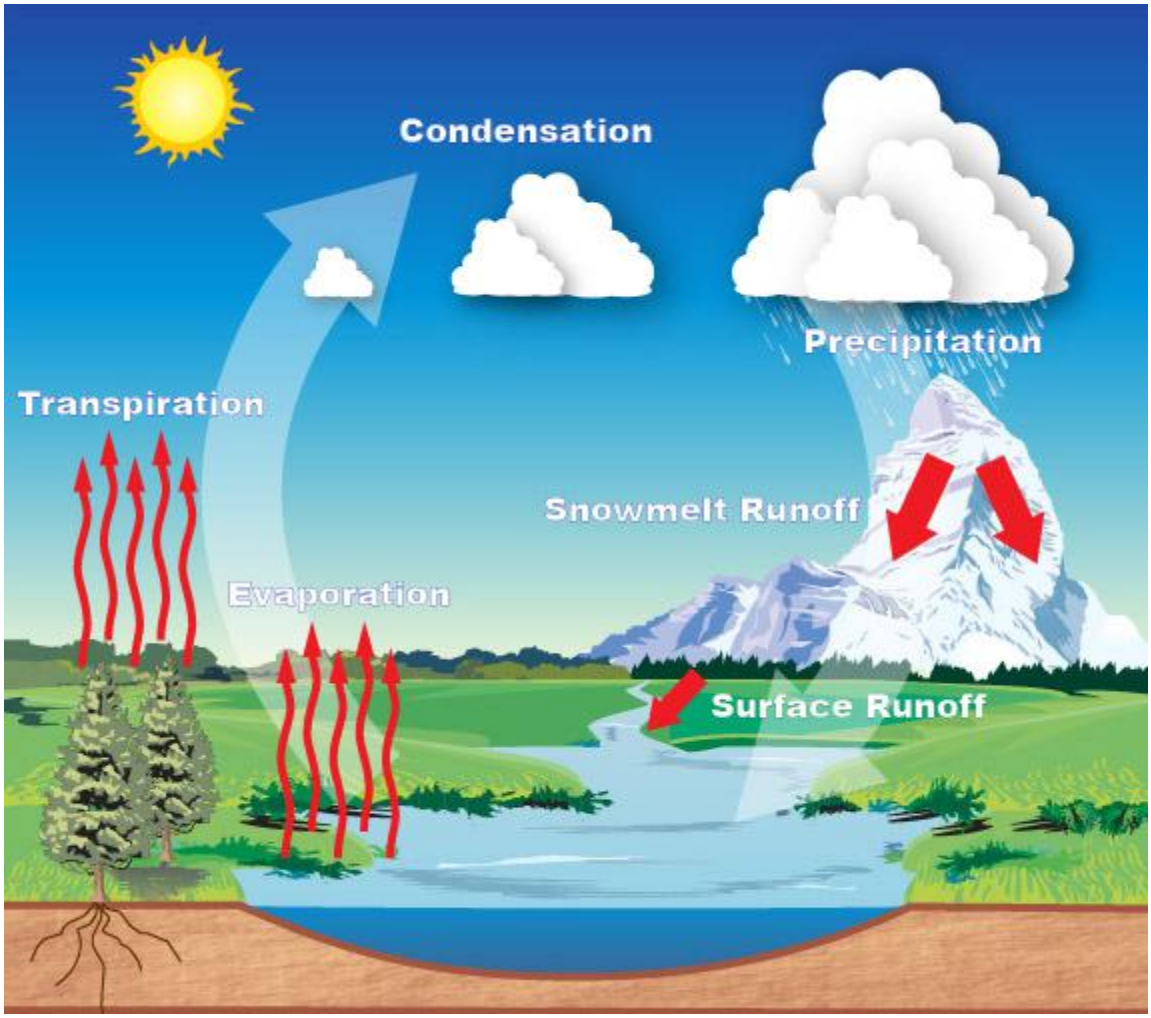
• These inter relationships manifest as natural cycles.(hydrologic cycle, oxygen cycle, nitrogen cycle, phosphorous cycle and sulphur cycle),

• The natural cycles operate in a balanced manner providing a continuous circulation of essential constituents necessary for life and this stabilizes and sustains the life processes on earth.



Hydrologic cycle

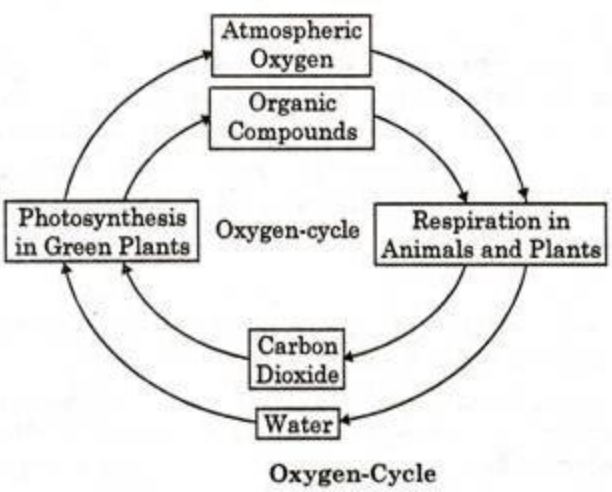
The hydrologic cycle involves a continuous exchange of water between sea, atmosphere, land and living animals through massive evaporation of water from the ocean, cloud formation and precipitation



The land surface and water surfaces on earth lose water by evaporation by solar energy. evaporation of water from ocean exceeds precipitation by rain into seas by 10% . This 10% excess which precipitates on land balances the hydrological cycle. Some of the precipitated rain seeps into the soil as ground water. Ground water moves up by capillary action and there by maintains a continuous supply of water to the surface layer of soil. The water from the surface layer of the soil is absorbed by plants, which in turn is returned to atmosphere through transpiration. Surface water or runoff flows into streams, rivers, lakes and catchment areas or reservoirs. Animals also take water which is also returned to the atmosphere through

evaporation. Thus there is always a balanced continuous cycling of water between earths surface and atmosphere.

Oxygen Cycle



Oxygen-Cycle

Nitrogen Cycle

Nitrogen cycle refers to the incorporation of N2 from the atmosphere into living matter and chemically bound nitrogen in soil, water and then back into the atmosphere again.

Nitrogen Fixation

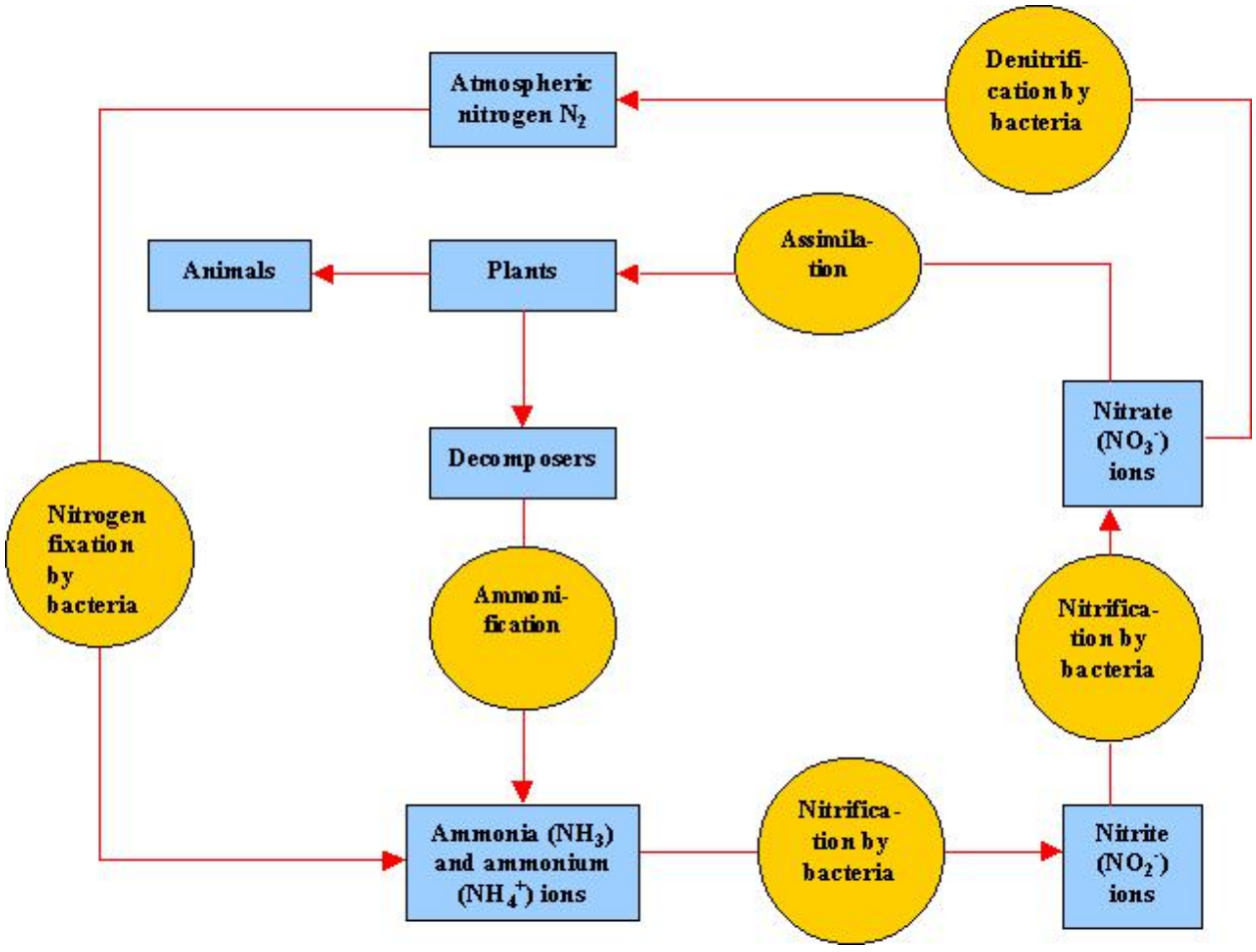
In this step the atmospheric nitrogen is chemically bound to form ammonia by bacteria and algae. Biological nitrogen fixation is mediated by organisms like Rhizobium that live a symbiotic relation with nodules on the roots of particular species of plants. These organisms are capable of catalysing the conversion of atmospheric nitrogen into forms usable by plants.

Nitrification

It is the conversion of N(-III) to N(V) catalysed by Nitrosomonas and Nitrobacter. Nitrification is important in nature, since nitrogen is absorbed by plants primarily as nitrate. Even when nitrogen is applied in the form of ammonium salts as fertilisers, the ammonia is microbially oxidized to nitrate so that it can be assimilated by plants.

Denitrification

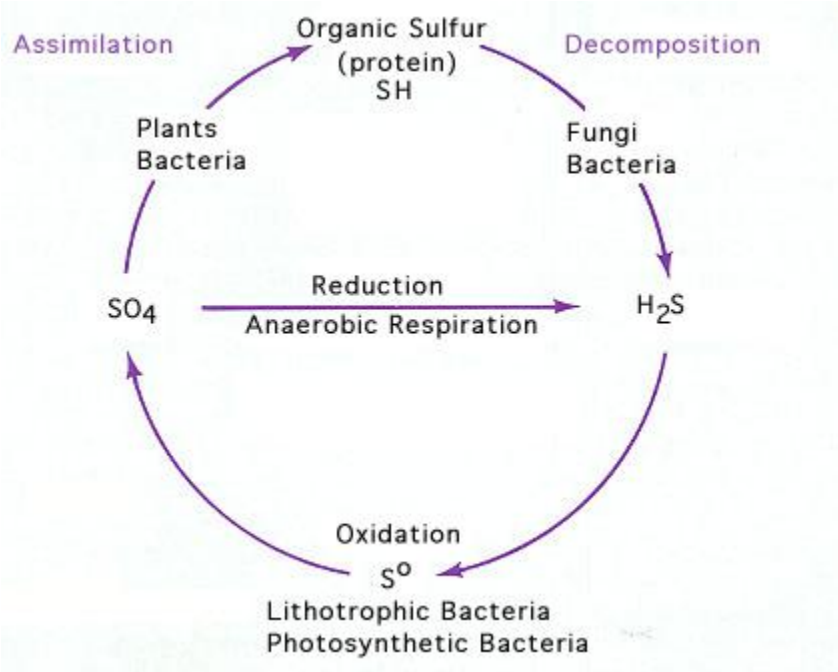
There are involves several steps. A number of heterotrophic bacteria including species of Pseudomonas and several types of denitrification reactions. One of these is the reduction of nitrate to form nitrogen gas. The process Anchromobacter mediate these processes. In this process N2 gas is produced from chemically fixed n



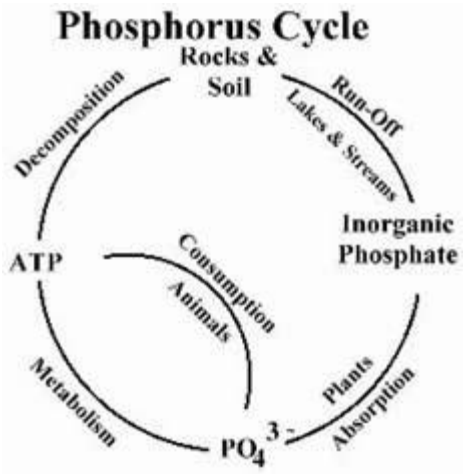
Sulphur Cycle

Sulphur is one of the components that make up proteins and vitamins. Proteins consist of amino acids that contain sulphur atoms. Sulphur is important for the functioning of proteins and enzymes in plants, and in animals that depend upon plants for sulphur. Plants absorb sulphur when it is dissolved in water. Animals consume these plants, so that they take up enough sulphur tomaintaintheirhealth.

Most of the earth's sulphur is tied up in rocks and salts or buried deep in the ocean in oceanic sediments. Sulphur can also be found in the atmosphere. It enters the atmosphere through both natural and human sources. Natural recourses can be for instance volcanic eruptions, bacterial processes, evaporation from water, or decaying organisms. When sulphur enters the atmosphere through human activity, this is mainly a consequence of industrial processes where sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) gases are emitted on a wide scale. When sulphur dioxide enters the atmosphere it will react with oxygen to produce sulphur trioxide gas (SO_3), or with other chemicals in the atmosphere, to produce sulphur salts. Sulphur dioxide may also react with water to produce sulphuric acid (H_2SO_4). Sulphuric acid may also be produced from demethylsulphide, which is emitted to the atmosphere by plankton species. All these particles will settle back onto earth, or react with rain and fall back onto earth as acid deposition. The particles will then be absorbed by plants again and are released back into the atmosphere, so that the sulphur cycle will start over again.



Phosphorous Cycle



The **phosphorus cycle** is the biogeochemical cycle that describes the movement of phosphorus through the lithosphere, hydrosphere, and biosphere. Phosphorus is an essential nutrient for plants and animals. Phosphorus is a limiting nutrient for aquatic organisms. Phosphorus forms parts of important life-sustaining molecules that are very common in the biosphere. Phosphorus does not enter the atmosphere, remaining mostly on land and in rock and soil minerals. Eighty percent of the mined phosphorus is used to make fertilizers. Phosphates from fertilizers, sewage and detergents can cause pollution in lakes and streams. Over enrichment of phosphate in both fresh and inshore marine waters can lead to massive algae blooms which, when they die and decay, leads to eutrophication of fresh waters only.

Air Pollution

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing diseases, allergies, death to humans, damage to other living organisms such as animals and food crops, or the natural or built environment. Air pollution may come from anthropogenic or natural sources.

Causes of Air pollution

1. Burning of Fossil Fuels: Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one the major cause of air pollution. Pollution emitting from vehicles including trucks, jeeps, cars, trains, airplanes cause immense amount of pollution. We rely on them to fulfill our daily basic needs of transportation. But, there overuse is killing our environment as dangerous gases are polluting the environment. Carbon Monooxide

caused by improper or incomplete combustion and generally emitted from vehicles is another major pollutant along with Nitrogen Oxides, that is produced from both natural and man made processes.

2. **Agricultural activities:** Ammonia is a very common by product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities has grown quite a lot. They emit harmful chemicals into the air and can also cause water pollution.

3. **Exhaust from factories and industries:** Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Manufacturing industries can be found at every corner of the earth and there is no area that has not been affected by it. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.

4. Mining operations: Mining is a process wherein minerals below the earth are extracted using large equipments. During the process dust and chemicals are released in the air causing massive air pollution. This is one of the reason which is responsible for the deteriorating health conditions of workers and nearby residents.

5. Indoor air pollution: Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution. Have you ever noticed that once you paint walls of your house, it creates some sort of smell which makes it literally impossible for you to breathe.

Suspended particulate matter popular by its acronym SPM, is another cause of pollution. Referring to the particles afloat in the air, SPM is usually caused by dust, combustion etc.

Effects of Air pollution

1. Respiratory and heart problems: The effects of Air pollution are alarming. They are known to create several respiratory and heart conditions along with Cancer, among other threats to the body. Several millions are known to have died due to direct or indirect effects of Air pollution. Children in areas exposed to air pollutants are said to commonly suffer from pneumonia and asthma.

2. **Global warming:** Another direct effect is the immediate alterations that the world is witnessing due to Global warming. With increased temperatures world wide, increase in sea levels and melting of ice from colder regions and icebergs, displacement and loss of habitat have already signaled an impending disaster if actions for preservation and normalization aren't undertaken soon.

3. **Acid Rain:** Harmful gases like nitrogen oxides and sulfur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combines with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to human, animals and crops.

4. Effect on Wildlife: Just like humans, animals also face some devastating affects of air pollution. Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat. The toxic pollutants deposit over the surface of the water and can also affect sea animals.

5. Depletion of Ozone layer: Ozone exists in earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere. As ozone layer will go thin, it will emit harmful rays back on earth and can cause skin and eye related problems. UV rays also have the capability to affect crops.

Solutions for Air Pollution

1. **Use public mode of transportation:** Encourage people to use more and more public modes of transportation to reduce pollution. Also, try to make use of car pooling. If you and your colleagues come from the same locality and have same timings you can explore this option to save energy and money.

2. Conserve energy: Switch off fans and lights when you are going out. Large amount of fossil fuels are burnt to produce electricity. You can save the environment from degradation by reducing the amount of fossil fuels to be burned.

3. Understand the concept of Reduce, Reuse and Recycle: Do not throw away items that are of no use to you. In-fact reuse them for some other purpose. For e.g. you can use old jars to store cereals or pulses.

4. Emphasis on clean energy resources: Clean energy **technologies**
like solar, wind and geothermalare on high these days. Governments of various countries have been providing grants to consumers who are interested in installing solar panels for their home. This will go a long way to curb air pollution.

5. Use energy efficient devices: CFL lights consume less electricity as against their counterparts. They live longer, consume less electricity, lower electricity bills and also help you to reduce pollution by consuming less energy.

Soil Pollution

Soil pollution is defined as, "contamination of soil by human and natural activities which may cause harmful effect on living organisms".

Causes and effects

Industrial wastes – Disposal of Industrial wastes is the major problem for soil pollution

Sources: Industrial pollutants are mainly discharged from various origins such as pulp and paper mills, chemical fertilizers, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc. Effect: These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil or water, disturb the biochemical process and finally lead to serious effects on living organisms.

Urban wastes – Urban wastes comprise of both commercial and domestic wastes consisting of dried sludge and sewage. All the urban solid wastes are commonly referred to as refuse. Constituents of urban refuse: This refuse consists of garbage and rubbish materials like plastics, glasses, metallic cans, fibres, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products. Urban domestic wastes though disposed off separately from industrial wastes, can still be dangerous. This happens because they are not easily degraded.

Agricultural practices – Modern agricultural practices pollute the soil to a large extent. With the advancing agro-technology, huge quantities of fertilizers, pesticides, herbicides and weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, debris, soil erosion containing mostly inorganic chemicals are reported to cause soil pollution

Radioactive pollutants/ - Radioactive substances resulting from explosions of nuclear testing laboratories and industries giving rise to nuclear dust radioactive wastes, penetrate the soil and accumulate giving rise to land/soil pollution. Ex:

1. Radio nuclides of Radium, Thorium, Uranium, isotopes of Potassium (K-40) and Carbon (C-14) are commonly found in soil, rock, water and air.
2. Explosion of hydrogen weapons and cosmic radiations include neutron, proton reactions by which Nitrogen (N-15) produces C-14. This C-14 participates in Carbon metabolism of plants which is then into animals and human beings.
3. Radioactive waste contains several radio nuclides such as Strontium90, Iodine-129, Cesium-137 and isotopes of Iron which are most injurious. Strontium get deposited in bones and tissues instead of calcium.
4. Nuclear reactors produce waste containing Ruthenium-106, Iodine-131, Barium-140, Cesium-144 and Lanthanum-140 along with primary nuclides Sr-90 with a half life 28 years and Cs-137 with a half life 30 years. Rain water carries Sr-90 and Cs-137 to be deposited on the soil where they are held firmly with the soil particles by electrostatic forces. All the radio nuclides deposited on the soil emit gamma radiations.
5. **Biological agents** – Soil gets a large amount of human, animal and bird excreta which constitute a major source of land pollution by biological agents.

Ex: 1. Heavy application of manures and digested sludge can cause serious damage to plants within a few years

Control measures of soil pollution

1. Soil erosion can be controlled by a variety of forestry and farm practices.

Ex: Planting trees on barren slopes ,Contour cultivation and strip cropping may be practiced instead of shifting cultivation, Terracing and building diversion channels may be undertaken. Reducing deforestation and substituting chemical manures by animal wastes also helps arrest soil erosion in the long term.

2. **Proper dumping of unwanted materials:** Excess wastes by man and animals pose a disposal problem. Open dumping is the most commonly practiced technique. Nowadays, controlled tipping is followed for solid waste disposal. The surface so obtained is used for housing or sports field.

3.Production of natural fertilizers: Bio-pesticides should be used in place of toxic chemical pesticides. Organic fertilizers should be used in place of synthesized chemical fertilizers. Ex: Organic wastes in animal dung may be used to prepare compost manure instead of throwing them wastefully and polluting the soil.

4.Proper hygienic condition: People should be trained regarding sanitary habits.

Ex: Lavatories should be equipped with quick and effective disposal methods.

5.Public awareness: Informal and formal public awareness programs should be imparted to educate people on health hazards by environmental education.

Ex: Mass media, Educational institutions and voluntary agencies can achieve this.

6.Recycling and Reuse of wastes: To minimize soil pollution, the wastes such as paper, plastics, metals, glasses, organics, petroleum products and industrial effluents etc should be recycled and reused.

Ex: Industrial wastes should be properly treated at source. Integrated waste treatment methods should be adopted.

7.Ban on Toxic chemicals: Ban should be imposed on chemicals and pesticides like DDT, BHC, etc which are fatal to plants and animals. Nuclear explosions and improper disposal of radioactive wastes should be banned.

MINAS - Minimum National Standards for polluting industries helps state pollution control board and other industries in implementing standards in a phased manner. These standards are evolved after consultation with experts and experienced people.

Air Quality Standards

Ambient air quality refers to the condition or quality of air surrounding us in the outdoors. National Ambient Air Quality Standards are the standards for ambient air quality set by the Central Pollution Control Board (CPCB) that is applicable nationwide. The CPCB has been conferred this power by the Air (Prevention and Control of Pollution) Act, 1981.

Ambient Air Quality Standards in India

The Air (Prevention and Control of Pollution) Act 1981 was enacted by the Central Government with the objective of arresting the deterioration of air quality. The Air (Prevention and Control of Pollution) Act 1981 describes the main functions of the Central Pollution Control Board (CPCB) as follows:

- To advise the Central Government on any matter concerning the improvement of the quality the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution; and
- To lay down and annul standards for the quality of air

National Ambient Air Quality Standards (NAAQS)

POLLUTANTS	Time Weighted Average	Concentration of Ambient Air			
		Industrial Area	Residential Rural and other area	Sensitive area	Method of Measurement
Sulphur Dioxide (SO2)	Annual Average 24 hours	80µg/m^3 120µg/m^3	60µg/m^3 80µg/m^3	15µg/m^3 30µg/m^3	Improved west and Gacke Method Ultraviolet fluorescence
Oxides of Nitrogen (NO2)	Annual Average	80µg/m^3	60µg/m^3	15µg/m^3	Jacab Hochheister

	24 hours	120µg/m^3	80µg/m^3	30µg/m^3	modified (Na-Arsentire method Gas Phase Chemilumine Scene
Suspended Particulate Matter (SPM)	Annual Average 24 hours	360µg/m^3 500µg/m^3	140µg/m^3 200µg/m^3	70µg/m^3 100µg/m^3	High Volume sampling (average flow rate not less than 1.1 m^3/minute)
Respirable Particulate Matter (size Less than 10µm) RPM	Annual Average 24 hours	120µg/m^3 150µg/m^3	60µg/m^3 100µg/m^3	50µg/m^3 75µg/m^3	Respirable particulate matter sampler
Lead as Pb	Annual Average 24 hours	1.0µg/m^3 1.5µg/m^3	0.75µg/m^3 1.0µg/m^3	0.50µg/m^3 0.75µg/m^3	AAS method after sampling using EPM 2000 or equivalent filter paper
Carbon Monoxide	8 hours 1 hour	5.0mg/m^3 10.0mg/m^3	2.0mg/m^3 4.0mg/m^3	1.0mg/m^3 2.0mg/m^3	Non disbersive infrared spectroscopy

Annual Average : Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24-hourly at uniform interval

24 Hours Average : 24-hourly/8-hourly values should be met 98% of the time in a year. However 2% of the time, it may exceeded but not two consecutive days.

1. The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutives values exceeds the limit specified above for the respective category, it shall be considered adequate, reason to institute regular/continuous monitoring and further investigations.

ACID RAIN

Acid rain is a result of air pollution. When any type of fuel is burnt, lots of different chemicals are produced. The smoke that comes from a fire or the fumes that come out of a car exhaust don't just contain the sooty grey particles that you can see - they also contains lots of invisible gases that can be even more harmful to our environment. Some of these gases (especially nitrogen oxides and sulphur dioxide) react with the tiny droplets of water in clouds to form sulphuric and nitric acids. The rain from these clouds then falls as very weak acid - which is why it is known as "acid rain".

Acid rain can be carried great distances in the atmosphere, not just between countries but also from continent to continent. The acid can also take the form of snow, mists and dry dusts. The rain sometimes falls many miles from the source of pollution but wherever it falls it can have a serious effect on soil, trees, buildings and water.

Control measures

Reduce emissions:

• Burning fossil fuels is still one of the cheapest ways to produce electricity so people are now researching new ways to burn fuel which don't produce so much pollution.

• Governments need to spend more money on pollution control even if it does mean an increase in the price of electricity.

• Sulphur can also be 'washed' out of smoke by spraying a mixture of water and powdered limestone into the smokestack.

• Cars are now fitted with catalytic converters which remove three dangerous chemicals from exhaust gases.

Find alternative sources of energy

• Governments need to invest in researching different ways to produce energy.

• Two other sources that are currently used are hydroelectric and nuclear power. These are 'clean' as far as acid rain goes but what other impact do they have on our environment?

• Other sources could be solar energy or windmills but how reliable would these be in places where it is not very windy or sunny?

• All energy sources have different benefits and costs and all theses have to be weighed up before any government decides which of them it is going to use.