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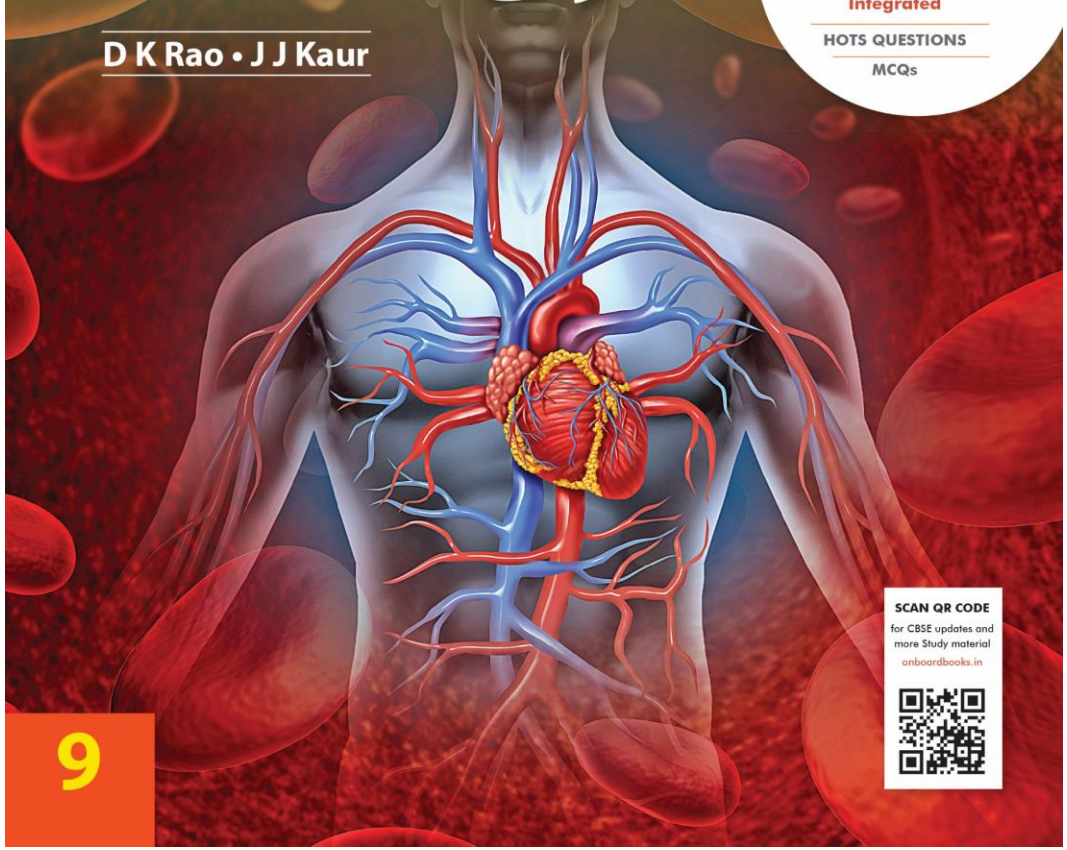

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CBSE
Living Science
Biology

Class 9

Chapter 5 Natural Resources

LEARNING OBJECTIVES

Natural Resources and the Biosphere

Air – The Breath Of Life

- **Role of the Atmosphere in Climate Control**
- **The Movement of Air – Winds**
- **How is Rain Caused?**
- **Air Pollution**

Water

- **Water Pollution**

Soil and Minerals

- **Soil pollution**

Biogeochemical Cycles– The Cycling of Materials In the Biosphere

- **Water or Hydrological Cycle**
- **Nitrogen Cycle**
- **Carbon Cycle**

Greenhouse Effect and Global Warming

- **Oxygen Cycle**
- **Ozone Layer Depletion**

What are Natural Resources?

All kinds of material that are required by man to meet his various basic requirements for survival and continuance are known as **resources**. These are obtained from nature, thus, they are known as **natural resources**. These natural resources are soil (land), water, air, etc.

Three Zones Where Natural Resources are Contained

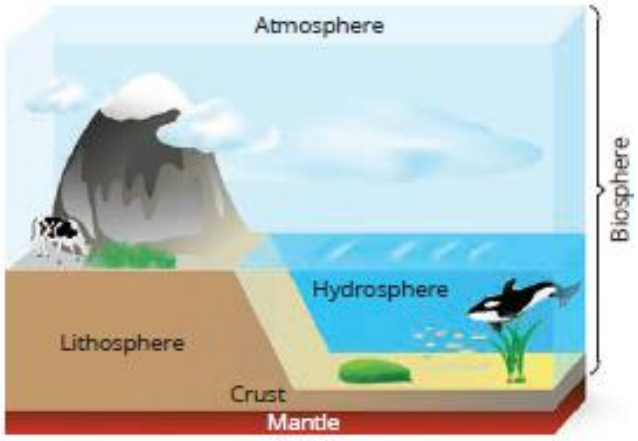
❖ **Lithosphere:** The outer crust of the earth is called lithosphere. Its upper weathered thin layer is called soil.

❖ **Hydrosphere:** The zone in which water exists is known as hydrosphere. Water covers about 75 per cent of the earth's surface occurring in oceans, river, lakes, ponds, dams, etc. It is also found in underground water resources.

❖ **Atmosphere:** The zone where air covers the earth like a blanket is called atmosphere. Living things are found only where all these three zones exist.

Biosphere

The life-supporting zone of earth where all these three zones, namely atmosphere, hydrosphere and lithosphere interact with each other, making life possible is called **biosphere**.



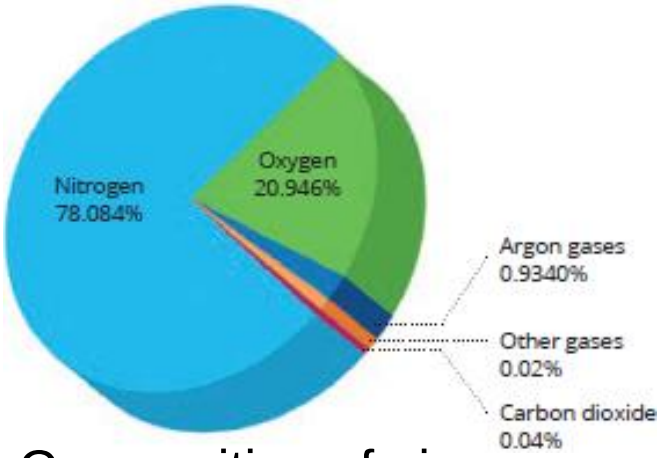
Components of biosphere – Biotic and abiotic

There are two components of biosphere – biotic and abiotic. The **biotic components of biosphere are the living things**. Various microorganisms, plants and animals form the biotic components of biosphere.

Those components of biosphere that do not have life are called abiotic or **non-living components**. Air, water, soil, light and temperature form the non-living or abiotic components of biosphere.

Air – The Breath of Life

Air is an important inexhaustible natural resource. It is a mixture of gases like oxygen (O_2), nitrogen (N_2), carbon dioxide (CO_2), ammonia (NH_3), argon, helium, ozone and water vapour. The composition of air is the basis of life on earth.



Composition of air

Importance of atmosphere (air)

- Oxygen in air is necessary for respiration.
- Oxygen is a supporter of combustion.
- Oxygen combines with almost all elements to form oxides.
- Nitrogen in air is required by plants to manufacture proteins.
- Carbon dioxide is an important component of air.
- Plants need carbon dioxide for producing food through photosynthesis.
- Carbon dioxide is used in fire extinguishers.
- Air movement causes winds and rains.

Role of the Atmosphere in Climate Control

The atmosphere keeps the average temperature of the earth steady during daytime and also around the whole year. It prevents the sudden increase in temperature during daytime. It also slows down the escape of heat into outer space during night and as a result does not let the weather become too cold during night.

The Movement of Air – Winds

Note: Refer to Activity 2 for the nature of convection current

How is water vapour formed?

Water vapour is formed due to the heating of waterbodies like oceans, lakes, rivers and ponds by sun's rays as well as due to the activities of living organisms. The atmosphere can be heated by the radiation that is reflected back or re-radiated by the land surface or by the waterbodies. As a result of being heated by the radiation, convection currents are set up in the air and water vapour is formed.

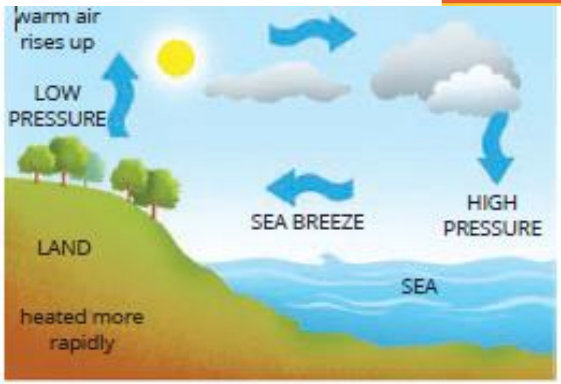
How is wind caused?

Wind is caused by differences in atmospheric pressure between two or more places. Air from area of high pressure moves towards area of lower pressure. This movement of air causes wind or breeze.

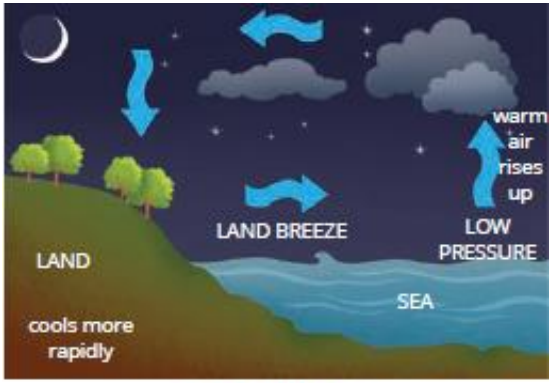
What is the direction of wind during day and night?

During day: The direction of the wind is from the sea to the land.

During night: Both land and sea start cooling down.



a. During day



b. During night

However, since water cools down slower than the land, the air above water would be warmer than the air above land. Hence, the direction of the wind is from the land to the sea.

How does air move in diverse directions?

This phenomena of movement of air in diverse directions is caused due to

- the uneven heating of land in different regions of the earth,
- the rotation of the earth,
- difference in the rates of vaporization and condensation of water vapour, and
- the presence of mountain ranges in the paths of wind which disrupt the easy flow of air.

How is Rain Caused?

❖ During daytime due to energy of the sun, waterbodies are heated and a large amount of water evaporates and goes into the air.

❖Some of the water vapour also gets into the atmosphere because of various biological activities.

❖At the same time, air also gets heated. It rises up and carries the water vapour with it.

❖ As the air rises up, it expands and cools down. This cooling causes the condensation of water vapour in the air into tiny droplets.

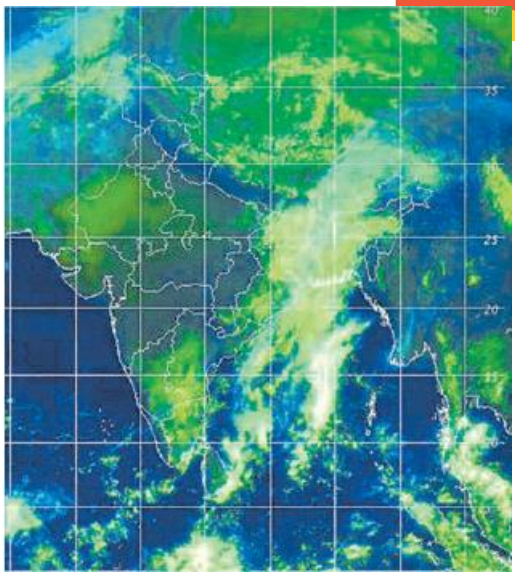
❖ This condensation of water is facilitated by some particles of dust that act as the ‘nucleus’ around which these drops are formed. Normally dust and other invisible particles are suspended in the air which help in the formation of droplets of water.

❖ The water droplets condense further and grow bigger in size. Soon the droplets grow so big and heavy that they can no longer remain suspended in the air and fall down in the form of rain drops.

❖ Sometimes, when the temperature of air is very low, water may precipitate in the form of snow, sleet or hail.

How are rainfall patterns decided?

Rainfall patterns are decided by the prevailing wind patterns. In large parts of India, rains are mostly brought about by the south-west or north-east monsoons. Sometimes the weather reports state that ‘depressions’ in the Bay of Bengal have caused rains in some areas. Monsoon winds are seasonal and associated with rainfall.



Satellite picture showing clouds over India

Air Pollution

Pollution may be defined as an undesirable change in the physical, chemical and biological characteristics of our surroundings that harms human life and other living beings. The substances that cause such changes, i.e. pollution, are called **pollutants**.

Air pollution may be defined as the occurrence or addition of foreign particles, gases and other materials into the air, which adversely affect the health of living organisms, vegetation, buildings and monuments.

Sources of air pollution

The substances that cause air pollution are known as **air pollutants**.

1. Carbon dioxide 2. Carbon monoxide 3.
3. Oxides of nitrogen and sulphur
4. Smog: Smog is a mixture of smoke, dust particles and small drops of fog formed due to condensation of water.

Effects of air pollution on human health

- Carbon monoxide combines with haemoglobin molecules in human blood and causes suffocation.
- Depletion of ozone layer due to CFCs causes skin cancer as a result of overexposure of the human skin to ultraviolet rays.
- Sulphur dioxide originated smog blocks the human respiratory system, which leads to death. Sulphur dioxide also causes diseases of the eyes, throat, nose and lung infections. It also causes acid rain.
- Nitric oxide (NO) in high concentration causes respiratory problems, internal bleeding, oxygen deficiency, pneumonia and lung cancer.

- Air pollutants like suspended particulate matter (SPM) cause asthma, lung cancer and asbestosis. Suspended particulate matter are small sized (particulate) air pollutants which remain suspended in air for a very long time. Smoke, dust, unburnt carbon particles (soot), fly ash, etc. form SPM.
- Air pollution reduces soil moisture and thus agricultural crops are damaged resulting in heavy economic losses to farmers.

Methods of controlling gaseous pollutants

Combustion: In this technique, organic pollutants are converted into less harmful products such as CO_2 and water vapour.

Absorption: In this technique, gaseous pollutants are passed through absorbing materials like scrubbers. This absorbent removes pollutants present in the gaseous effluents.

Adsorption: Adsorption is a process in which a substance sticks to the surface of another substance (called adsorbent). In this technique, gaseous effluents are passed through porous solid adsorbents kept in suitable containers. The gaseous pollutants stick or are adsorbed on the surface of the porous material and clean air can pass through.

Water Pollution

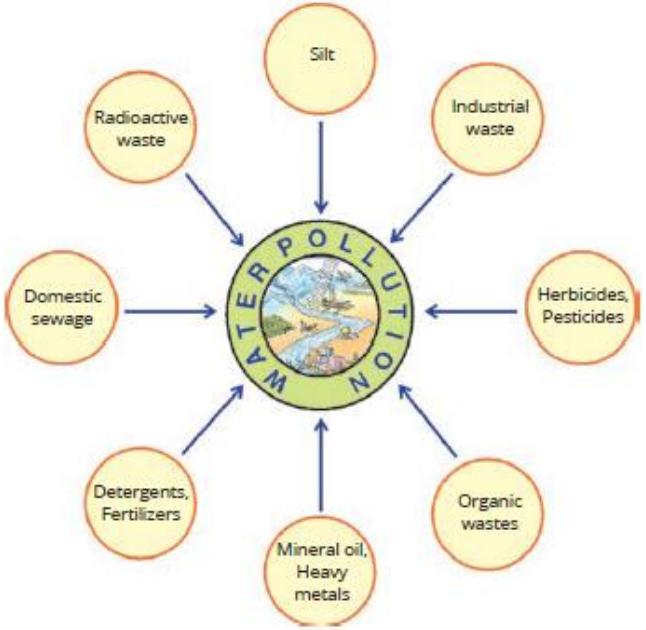
Water pollution may be defined as a change in physical, chemical and biological properties of water by the addition of undesirable substances or the removal of desirable substances from waterbodies or a change in temperature of water, which may have harmful effects on human and aquatic life.

Sources of water pollution

Water gets polluted in many ways:

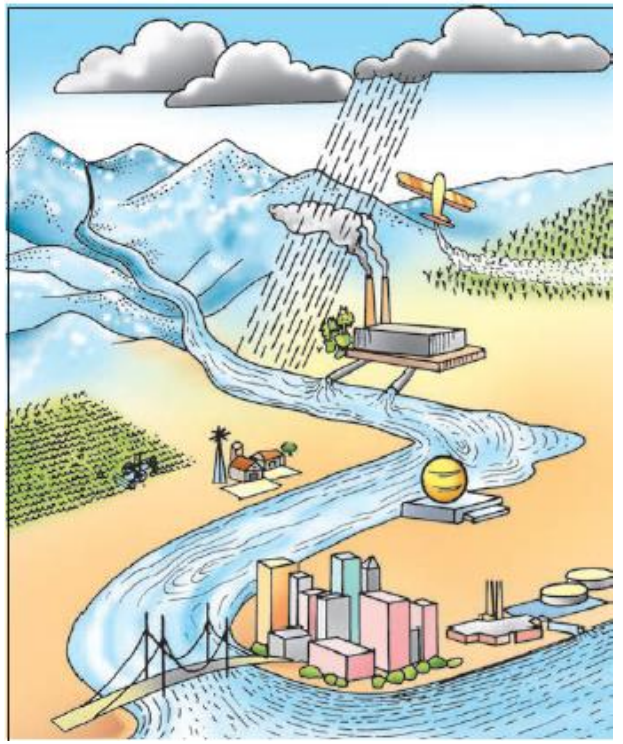
Fertilizers and pesticides: Fertilizers and pesticides are used in farms to get higher yields of food crops. These fertilizers and pesticides dissolve in water and are washed into waterbodies like lakes and rivers.

Domestic sewage: The sewage from our houses is discharged into rivers and lakes.



Industrial wastes: Our industries produce lot of waste containing high concentration of oil, heavy metals and detergents. This waste is dumped into rivers or lakes. There are many industries which use water for cooling in various operations and later return this hot water to waterbodies, which raises its temperature.

Dams: Water inside deep reservoirs is colder than water at the surface that gets heated due to sun rays. When this water is released from dams, it changes the temperature of waterbodies and affects the aquatic life.



Thus, the term water pollution can be used to cover the following aspects:

Addition of undesirable substances to water-bodies, like fertilizers and pesticides used in farming; or poisonous substances, such as mercury salts which are used in paper industries to manufacture paper; or disease-causing microorganisms such as bacteria which cause cholera.

Prevention and control of water pollution

Some steps that may reduce water pollution are:

- Setting up sewage water treatment plants.
- Use of septic tanks in houses to avoid direct dumping of faecal matter and other wastes.
- Avoiding contamination of rivers, lakes and ponds by washing clothes, bathing, etc.

- Not throwing waste food materials, paper, biodegradable vegetables and plastic into open drains.
- Treating industrial effluents before discharging into rivers making separate channels for river and sewage water.
- Generating public awareness about the maintenance of ponds, river, lakes and wells in rural and urban areas.

Soil and Minerals

Soil formation – Pedogenesis

The process of breaking down of huge pieces of rocks and its minerals into fine particles due to continuous action of physical, chemical and biological agents is called **weathering**. Depending on the type of natural agent involved, weathering can be classified as physical, biological and chemical weathering.

Physical weathering

The Sun: During daytime, rocks get heated. As a result, they expand. At night, when the temperature lowers down, these rocks cool down and contract. However, all parts of rocks do not expand or contract at the same rate. As a result of difference in the rate of contraction in various parts of rocks, cracks are formed in the rocks. Ultimately, huge rocks break down into smaller pieces of soil particles.

Water: Water gets into the cracks in the rocks which are formed due to uneven heating by the sun. Later when this water freezes, it causes the cracks to widen. Water flowing over the rocks over long periods of time wears away even hard rock. Fast flowing water often carries big and small particles of rock downstream. During water flow, these rocks hit other rocks and the resultant collisions cause the rocks to break into smaller and smaller particles. These particles are then taken along by water and deposited to far away places from its parent rock.

Wind: Strong winds erode rocks down. They also carry sand from one place to the other like water does.

Biological weathering

Weathering of rocks by biological components like animals, plants and microbes is known as **biological weathering**. Organisms like lichens and mosses grow on the surface of rocks. While growing, they release certain substances that erode the rock surface to powder and form a thin layer of soil. When other small plants like moss, grow on this surface, they further break it down.

The roots of big trees go into cracks in the rocks and as the roots grow bigger, the cracks become wider leading to weathering.

Chemical weathering

There are many chemical substances present in rocks like sulphates, chlorides and phosphates of calcium, potassium and magnesium. During weathering, these chemicals are converted into solution and make the rocks porous leading to further disintegration. Water also hydrolyses certain minerals in rocks causing weathering.

Components of soil

Note: Refer to the Activity 10 for Components of Soil

Soil pollution

Removal of useful components from the soil and addition of other substances, which adversely affect the fertility of the soil and kill the diversity of organisms living in it, is called **soil pollution**.

Causes of soil pollution

Soil pollution is mainly caused by the following:

- Raw manure (farm and animal manure containing pathogens)
- Agricultural waste (chemical fertilizers and pesticides)
- Industrial waste (fly ash, metallic ash, etc.)
- Domestic waste (paper pulp, plastic, polythene bags, rubber, discarded gadgets, glass, metal scrap, etc.)

Prevention of soil pollution

Soil pollution can be prevented by:

- judicious use of fertilizers and pesticides,
- controlling the release of effluents from industries into the soil and
- using safe methods of disposal of raw manure and domestic waste.

Soil erosion

Soil erosion also plays a role in the reduction of soil fertility. The removal and transportation of the top layer of soil from its original position to another place by flowing water or wind is called **soil erosion**.

Causes of soil erosion

The fine particles of soil may be carried away by flowing water or wind. This exposes the rocks underneath and leads to loss of a valuable resource because very little vegetation will grow on the rock. Large scale deforestation has also resulted in soil erosion. Topsoil that is devoid of vegetation is likely to be removed very quickly. This is found more accelerated in hilly regions. Thus, the causes of soil erosion may be strong winds, heavy rain, improper farming, dust storms, frequent floods and also indiscriminate human activities. Once soil is eroded, it is very difficult to reverse the process of soil erosion.

Prevention of soil erosion

From above activity, we may conclude that **soil erosion can be checked by growing more trees on a barren land**. This is because the roots of plants bind soil particles and prevent them from getting washed away with water or blown away by wind. On hillsides, if terrace farming (farming on slopes of hills by making small steps) is practised, soil erosion is slowed down. Along with checking soil erosion, vegetative cover on the ground also helps in the percolation of water into the deeper layers. In addition, sowing grasses, planting xerophytes, contour bunding (making soil elevation bunds) and making proper drainage canals around the fields also helps in preventing soil erosion.

Biogeochemical Cycles– The Cycling of Materials in the Biosphere

The circulation of matter or biogenic nutrient elements like carbon, hydrogen, oxygen, nitrogen, phosphorus, calcium, water and energy between biotic (living) world and abiotic (physical/non-living) world is known as the **biogeochemical cycle**.

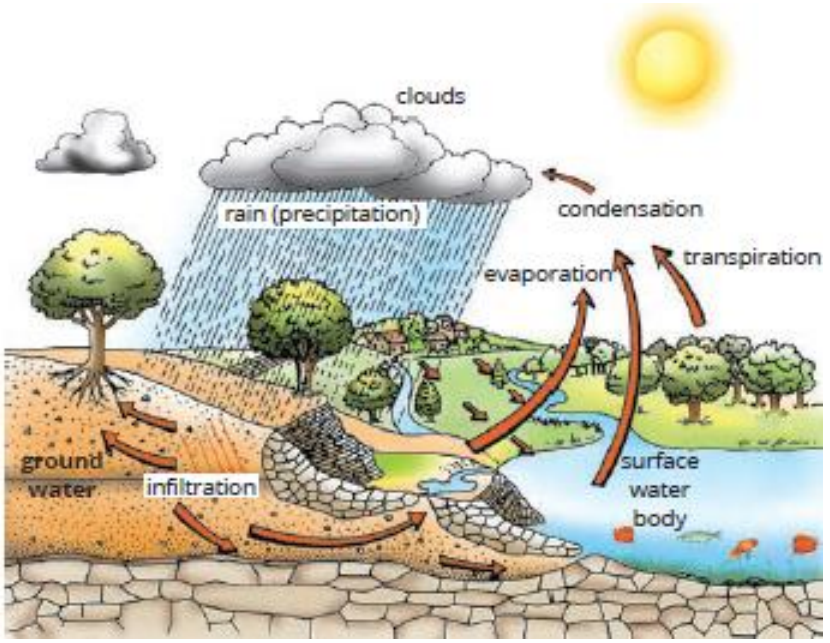
Characteristics of biogeochemical cycle

- In biogeochemical cycles, materials are not lost but recycled.
- There is regular circulation of biogenic nutrient elements between abiotic and biotic component of the biosphere

- It operates through non-living world (air, water, soil) and living world.
- Decomposers help in recycling of materials. They convert nutrients into usable forms.
- It helps in maintaining nutrient pool of the earth.

Water or hydrological Cycle

Water cycle is the circulation of water within the earth's hydrosphere which involves continuous exchange of water between the atmosphere, land, surface and ground water and living beings. In other words, the whole process of evaporation of water, its falling on land as rains, and later its flowing into the sea via rivers is known as water cycle.



Steps of water cycle

Evaporation: It is the transfer of water from the surface of waterbodies like rivers, oceans, etc. into the atmosphere as water vapour.

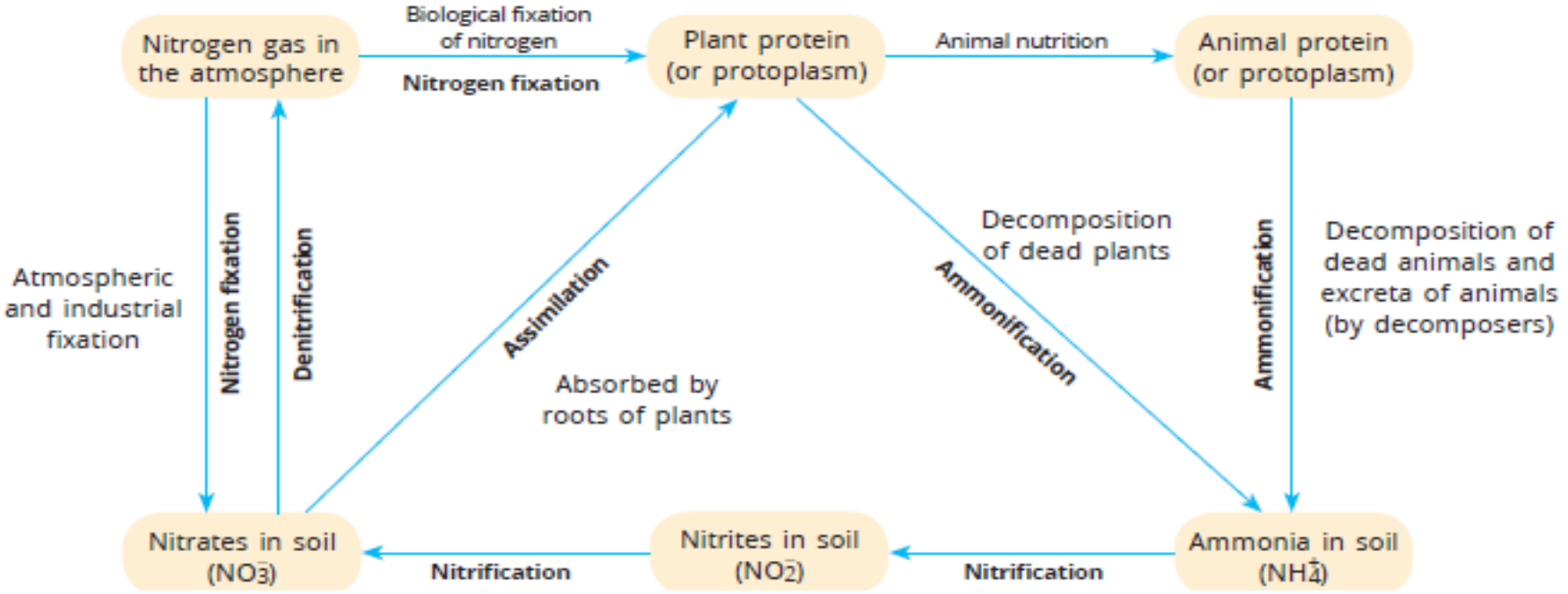
Condensation: The water vapours being lighter rise up and condense to form tiny water droplets. These tiny droplets round up around the dust particles available in the atmosphere and form clouds.

Precipitation: The water vapours that condense to form clouds precipitate to form rain and snow.

Infiltration: All the rainwater falling on the land does not flow to the sea. Some of it seeps into soil and becomes part of the underground reservoir of fresh water.

Nitrogen Cycle

The cyclic process by which nitrogen is circulated continuously between the living and non-living components of the biosphere is called the nitrogen cycle.



Steps of nitrogen cycle

Nitrogen fixation

The process of converting free nitrogen of the atmosphere into nitrogen compounds is called **nitrogen fixation**. It takes place in two ways:

- Atmospheric nitrogen fixation
- Biological nitrogen fixation

Atmospheric nitrogen fixation

During lightning in the sky, when high temperature and pressure are created in the air, the nitrogen gas present in the atmosphere reacts with oxygen to produce oxides of nitrogen. These oxides of nitrogen dissolve in rainwater forming dilute nitric and nitrous acids, and fall on the land along with rainwater. These nitric and nitrous acids react with the alkalis of the soil (like limestone) to turn into nitrates, which are utilized by various plants.

$$N_2 + O_2 \rightarrow 2NO$$

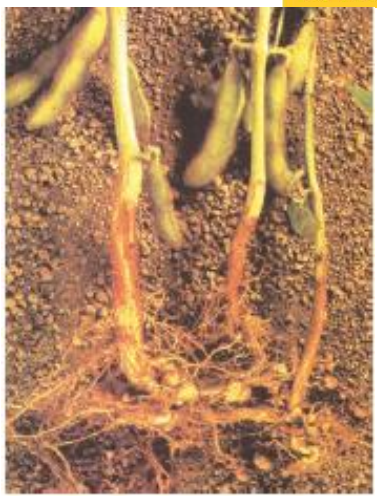
$$2NO + O_2 \rightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$$

$$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$$

Biological nitrogen fixation

It is the conversion of atmospheric nitrogen into nitrogen compounds by nitrogen-fixing bacteria. Nitrogen-fixing bacteria can be free-living like *Azotobacter* and *Clostridium*, or symbiotic like *Rhizobium.* These bacteria live in the root nodules of dicot leguminous plants and can fix atmospheric nitrogen into nitrates.



Root nodules of leguminous plants contain nitrogen fixing bacteria

Certain blue-green algae like *Anabaena* and *Nostoc* and non-leguminous plants like *Ginkgo* can also fix atmospheric nitrogen into nitrates.

Nitrogen assimilation

The process of conversion of inorganic nitrogen compounds (ammonia salts and nitrates) into organic compounds (amino acids, nucleotides, etc.) that become a part of living organisms is called **nitrogen assimilation**. Plants absorb nitrogen compounds like nitrates and nitrites from the soil and water, and convert them into amino acids which in turn form plant proteins. Other complex organic compounds containing nitrogen are also formed by using some other biochemical pathways. These proteins and complex compounds are subsequently consumed by animals.

Ammonification

The process of conversion of complex organic compounds like proteins of dead and decaying organisms into ammonia is called **ammonification**.

Nitrification

The process of conversion of ammonia into nitrites and nitrates is called **nitrification**. Nitrification is brought about by some nitrifying bacteria present in the soil. Nitrates from the soil are absorbed by the plants. Energy is yielded in the process which is used by these bacteria.

Denitrification

The conversion (degradation) of nitrate and nitrite salts to elemental nitrogen is called **denitrification**. It is carried out in the soil by free-living bacteria called *Pseudomonas*.

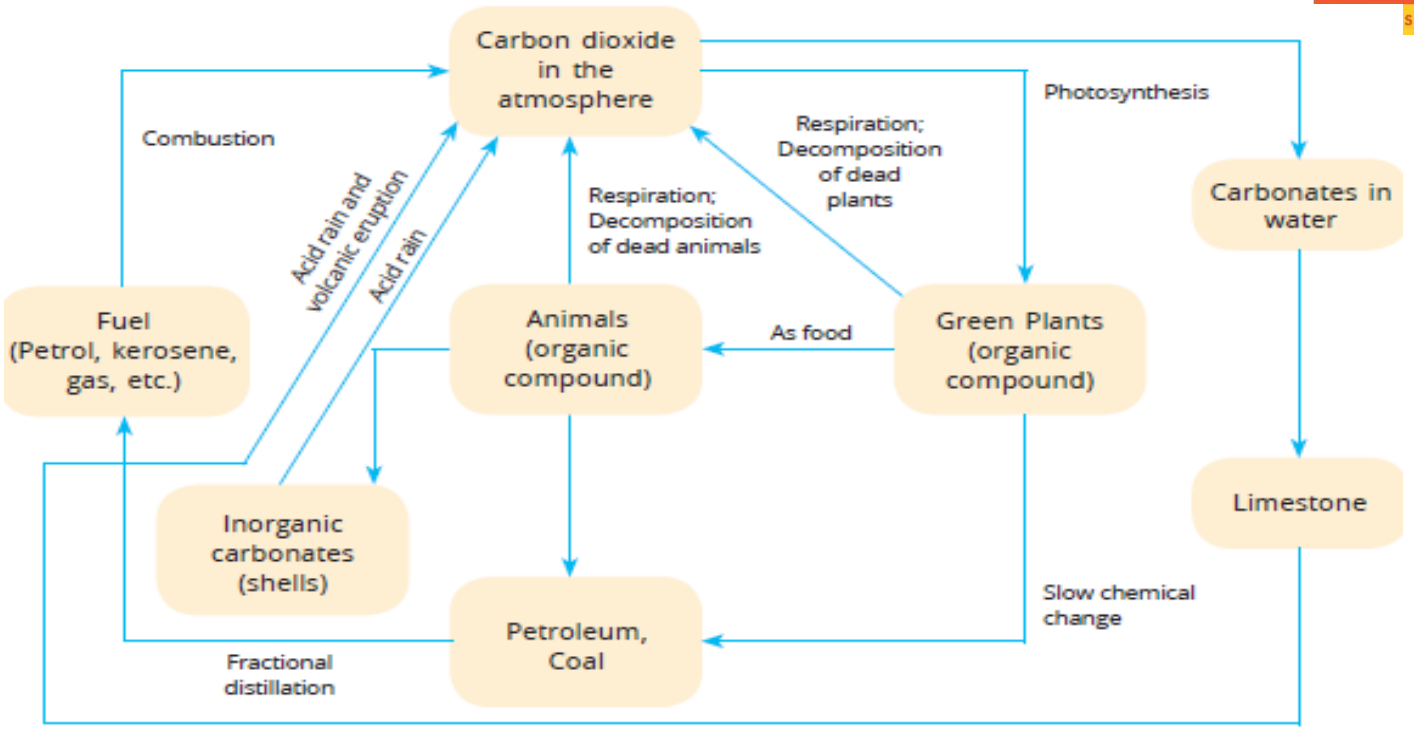
Carbon Cycle

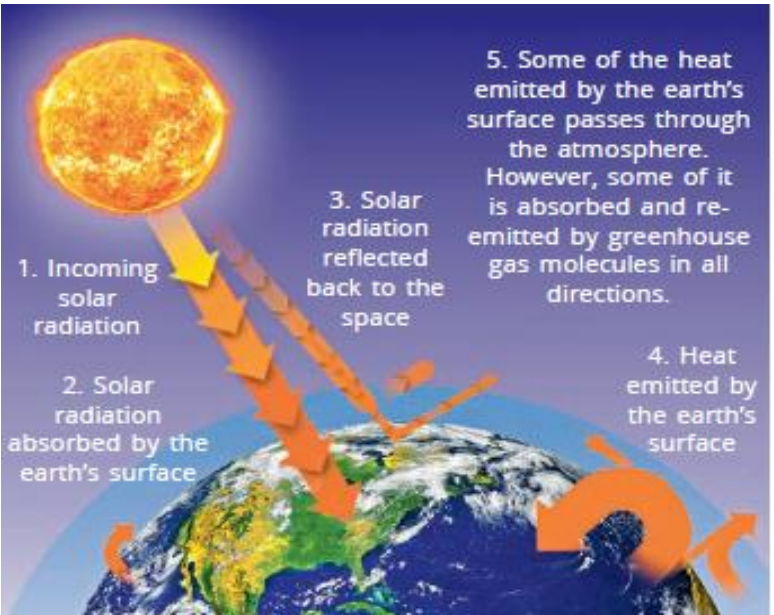
The cyclic process in which carbon is circulated continuously between the living and non-living components of the biosphere is called carbon cycle.
There is a continuous exchange of carbon dioxide between atmosphere, waterbodies and living beings through physical and biological activities.

Steps of carbon cycle

1. Through photosynthesis 2. By combustion

Carbon Cycle in nature





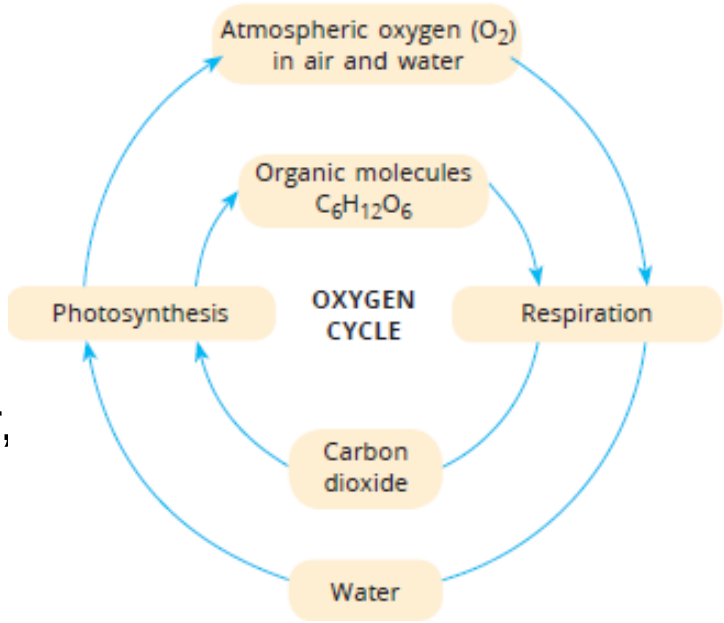
Greenhouse Effect and Global Warming

There are some gases such as carbon dioxide which prevent the escape of heat from the earth. An increase in the percentage of such gases in the atmosphere would increase the average temperature worldwide.

This is called the greenhouse effect. Methane and carbon dioxide are considered as the **greenhouse gases**. An increase in the carbon dioxide or methane content in the atmosphere causes more heat to be trapped and retained by the atmosphere, leading to **greenhouse effect**.

Oxygen Cycle

The cycle that maintains the levels of oxygen in the atmosphere is known as **oxygen cycle**. Oxygen is used up in the atmosphere by three processes, namely (i) combustion, (ii) respiration and (iii) formation of oxides of nitrogen. However, oxygen is returned to the atmosphere by autotrophs during photosynthesis.



The concentration of oxygen in the air and water is maintained since the rate of its release during photosynthesis and use during respiration remain almost the same.

Ozone Layer Depletion

In the upper part of the atmosphere, oxygen is present in the form of **ozone**. Ozone is an allotrope of oxygen. It is made of 3 atoms of oxygen (triatomic). Ozone is poisonous.

However, it is not stable near the earth's surface. Ozone is present mostly in the stratosphere and its maximum concentration occurs at a height of 23–25 km above the equator or at slightly lower height at other places.

What are the ill effects of ozone layer depletion?

At ground level, ozone is a harmful pollutant that damages plants and building materials, and is hazardous to human health. However, in the upper atmosphere, ozone is very important and acts like a life cover. It protects us by absorbing the dangerous ultraviolet (UV) rays coming from the sun. Without the ozone layer, organisms on the earth would be subjected to life threatening radiations from sun.

Ozone layer depletion – ozone hole

The 'ozone hole' is increasing every year. It is difficult to imagine the consequences for life on earth if ozone layer depletion continues further.

What causes ozone layer depletion?

There are many man-made compounds such as chlorofluorocarbons (CFCs) which are found persisting in the atmosphere. CFCs are very stable molecules. When they diffuse into the atmosphere, they react with the UV radiations from the sun and release chlorine atoms that destroy ozone. This results in the reduction of the ozone layer.

SUMMARY...

❖ Natural resources like air, water, soil, etc. are useful to mankind as they provide us food, clothes and shelter.

❖The life supporting zone of earth is called biosphere. There are mainly three zones of biosphere, namely lithosphere, hydrosphere and atmosphere.

❖Air is used for respiration, combustion, moderating temperature and bringing rains.

❖An undesirable change in the physical, chemical and biological characteristics of our surroundings that has harmed human life and other living beings is known as pollution.

❖Air pollution may be defined as the occurrence of foreign particles, gases and other materials in air which have adverse effects on biological communities and physical surroundings.

❖Carbon monoxide, carbon dioxide, oxides of nitrogen and sulphur, smog, suspended particulate matter and pesticides are some common air pollutants.

❖Uneven heating of air over land and waterbodies causes winds.

❖Rains are formed due to evaporation of water from waterbodies and subsequent condensation.

- All living beings need water to carry out various life processes. Water is the prime constituent of all living cells.
- Water may be polluted by pesticides, chemicals, industrial and domestic waste.
- Soil is formed mainly by weathering of rocks by winds, water and rise and fall in temperatures. Biological components also help in soil formation.
- Circulation of matter or nutrients and energy between biotic and abiotic components is known as biogeochemical cycle.
- The process of converting free nitrogen of the atmosphere into nitrogen compounds is called nitrogen fixation.
- *Azotobacter*, *Clostridium* and *Rhizobium* are nitrogen fixing bacteria.
- In the upper atmosphere, ozone acts like a life cover that protects us by absorbing the dangerous ultraviolet rays of the sun. Man-made compounds such as chlorofluorocarbons have caused a hole in the ozone layer.

THANK YOU