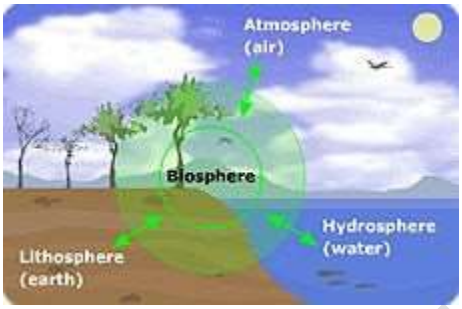
Natural Resources

The land, the water and the air are the resources on the Earth

The four main spheres of Earth:



1. lithosphere 2.hydrosphere 3.atmosphere 4.biosphere

The four spheres show how the four main components of Planet Earth form a complete system. These main components are land, air, water, and life. The names of each of these spheres come from Greek words that describe what they're made of.

Lithosphere is also known as Geosphere. '**Geo**' means 'ground. The outer crust of the Earth is called the lithosphere. Earth's lithosphere includes the crust and the uppermost mantle, which constitute the hard and rigid outer layer of the Earth. The lithosphere is the most rigid of Earth's layers.

Hydrosphere-'hydro' means 'water,' the **hydrosphere** is composed of all of the water on or near the earth. This includes the oceans, rivers, lakes, and even the moisture in the air. The hydrosphere is found on the surface of Earth, but also extends down several miles below, as well as several miles up into the atmosphere(as water vapors). It is the only planet in the Solar System with a hydrological cycle. Hydrosphere makes up about three fourths of the earth's surface.

Atmosphere-'**atmo**' means 'air. The air that covers the whole of the Earth like a blanket is called the atmosphere.

Biosphere– bio' means 'life. The life-supporting zone of the Earth where the atmosphere, the hydrosphere and the lithosphere interact and make life possible is known as the biosphere. Biosphere comprises of both biotic and abiotic components.

- Biotic components include all the living organisms.
- Abiotic components include air, water and the soil.

The Breath of Life: Air

Air is a mixture of many gases like nitrogen, oxygen, carbon dioxide and water vapour. On Venus and Mars there is no life because carbon dioxide constitutes 95-97% of the atmosphere.

Carbon dioxide is produced in the atmosphere by following activities:

1. Breakdown of glucose in presence of oxygen by organisms.
2. Combustion of fuels.

Carbon dioxide is fixed in two ways:

1. Green plants convert carbon dioxide into glucose by photosynthesis.
2. Marine animals use carbonates dissolved in sea-water to make their shells.

THE ROLE OF THE ATMOSPHERE IN CLIMATE CONTROL

The air is a bad conductor of heat. The atmosphere (envelope of air that surrounds the earth) acts as a protective blanket for the living organisms to exist in the following way:

It keeps the average temperature of the earth fairly steady during the day and even during the course of the whole year. The atmosphere does so by preventing the sudden increase in temperature during the daylight hours. Further, during the night, it slows down the escape of heat into the outer space. In contrast, the situation on the moon is quite different which is about the same distance from the sun that the earth is. Moon has no atmosphere and the temperature on the surface of the moon ranges from -190o C to 110^{o}C.

THE MOVEMENT OF AIR: WINDS

Moving air is called wind. Air moves from high pressure area to a low pressure area. Motion of wind is the result of two changes taking place in the atmosphere-

i) Heating of air

ii) Formation of water vapour. Water vapour is formed due to the heating of water bodies and the activities of living organisms.

The atmosphere can be heated from below by the radiation that is reflected back or re-radiated by the land or water bodies. On being heated, convection currents are set up in the air. When air is heated by radiation from the heated land or water, it rises. But since land gets heated faster than water, the air over land would also be heated faster than the air over water bodies and starts rising. As this air rises, a region of low pressure is created and air over the sea moves into this area of low pressure. The movement of air from one region to the other creates winds.

Various other factors also influence these winds –

1. The rotation of the Earth
2. The presence of mountain ranges in the paths of the wind.

Formation of rain:

When water bodies are heated during the day, a large amount of water evaporates and goes into the air. Some amount of water vapour also gets into the atmosphere because of various biological activities. This air also gets heated. The hot air rises up carrying the water vapour with it. As the air rises, it expands and cools. This cooling causes the water vapour in the air to condense in the form of tiny droplets. This condensation of water is facilitated if some particles could act as the 'nucleus' for these drops to form around. Normally dust and other suspended particles in the air perform this function. Once the water droplets are formed, they grow bigger by the 'condensation' of these water droplets. When the drops have grown big and heavy, they fall down in the form of rain. Sometimes, when the temperature of air is low enough, precipitation may occur in the form of snow, sleet or hail.

Rainfall patterns are decided by the prevailing wind patterns. In large parts of India, rains are mostly brought by the southwest or north-east monsoons. We have also heard weather reports that say 'depressions' in the Bay of Bengal have caused rains in some areas

Air pollution

An undesirable change in the physical, chemical or biological characteristics of the air making it harmful for the living organisms (including man) is termed air pollution. In other words, addition of unwanted and harmful substances in the air or increase in the quantities of constants of air beyond the normal level that affects the living organisms is called air pollution. Agents or substances that pollute the air are called air pollutants.

Indicators of air pollution:

Presence or absence of certain organisms indicates air pollution. Organisms called lichens are found to be very sensitive to the levels of contaminants like sulphur dioxide in the air. Lichens can be commonly found growing on the barks of trees as a thin greenish-white crust. Lichen vegetation and mosses gets completely destroyed when the level of SO_2 increases. Therefore, lichens are not found in cities and towns having vehicular pollution.

Water

Water is called the fluid of life. 75% of the earth's surface is covered by water, 97% of which forms oceans and only 3% forms fresh water. Water exists in solid, liquid and gaseous forms. It occurs in atmosphere, on land surface as well as underground.

Composition of water:

Water is composed of hydrogen and oxygen. Its chemical formula is H_2O.

TYPES OF WATER RESOURCES: – Water resources can be classified into two types

(i) Fresh water resources- Fresh water is found frozen in the ice-caps at the two poles and on snow covered mountains. The underground water and the water in rivers, lakes and ponds are also fresh.

(ii) Salt water resources- Most of the water on Earth's surface is found in seas and oceans and is saline

IMPORTANCE OF WATER:-

The importance of water to the life of plants can be emphasized best by enlisting its functions:

– Water is the main constituent of protoplasm.
– It is the solvent through which mineral salts are transported from one part of the plant to the other.
– Various metabolic reactions take place in a medium containing water.
– It acts as a reactant in numerous metabolic reactions.
– During photosynthesis, water releases oxygen.
– Turgidity of the growing cells is maintained with water.
– Various movements of plant organs live movements insensitive plant (touch-me-not) are controlled by water.
– The growth of the cells during elongation phase is mainly dependent on absorption of water.
– Metabolic end product of respiration is water.
– Places having plenty of water have more biodiversity.

Water is important to living organisms because:

1. All cellular processes require an aqueous medium.
2. Dissolved substances are needed for body reactions as well as for transportation. Osmoregulation is carried out by all organisms to sustain life.

Water pollution:

Water pollution: The addition of undesirable substances to water and removal of desirable substances from water is called water pollution.

The main causes of water pollution are as follows:

1. Addition of harmful substances to water
2. Removal of desirable substances from water
3. Change in water temperature.

(i) Addition of harmful substances to water

– Chemical wastes from industries. E.g., Mercury salt from paper industries.
– Sewage and wastes from houses.
– Pesticides and fertilizers
– Disease carrying organisms from industries. E.g., cholera

(ii) Removal of desirable substances from water

Dissolved oxygen is used by the animals and plants that live in water. Any change that reduces the amount of this dissolved oxygen would adversely affect these aquatic organisms. Other nutrients could also be depleted from the water bodies.

(iii) Change in temperature

Aquatic organisms are used to a certain range of temperature in the water-body where they live, and a sudden marked change in this temperature would be dangerous for them or affect their breeding. The eggs and larvae of various animals are particularly susceptible to temperature changes.

Mineral riches in the soil:

Soil is an important resource that decides the diversity of life in an area. The outermost layer of our Earth is called the crust and the minerals found in this layer supply a variety of nutrients to life-forms. Over long periods of time, thousands and millions of years, the rocks at or near the surface of the Earth are broken down by various physical, chemical and some biological processes. The end product of this breaking down is the fine particles of soil.

Soil is a mixture. It is the portion of earth surface consisting of various components like small particles of rock (of different sizes, bits of decayed living organisms which are called **humus**, various forms of microscopic life, air and water.

The factors or processes that make soil:

• **The Sun:** The Sun heats up rocks during the day so that they expand. At night, these rocks cool down and contract. Since all parts of the rock do not expand and contract at the same rate, this results in the formation of cracks and ultimately the huge rocks break up into smaller pieces.

• **Water:** Water helps in the formation of soil in two ways. One, water could get into the cracks in the rocks formed due to uneven heating by the Sun. If this water later freezes, it would cause the cracks to widen. Two, flowing water wears away even hard rock over long periods of time. Fast flowing water often carries big and small particles of rock downstream. These rocks rub against other rocks and the resultant abrasion causes the rocks to wear down into smaller and smaller particles. The water then takes these particles along with it and deposits it further down its path. Soil is thus found in places far away from its parent rock.

• **Wind:** In a process similar to the way in which water rubs against rocks and wears them down, strong winds also erode rocks down. The wind also carries sand from one place to the other like water does.

•**Living organisms** also influence the formation of soil. The lichen that we read about earlier also grows on the surface of rocks. While growing, they release certain substances that cause the rock surface to powder down and form a thin layer of soil. Other small plants like moss are able to grow on this surface now and they cause the rock to break up further. The roots of big trees sometimes go into cracks in the rocks and as the roots grow bigger, the crack is forced bigger.

Type of soil is decided by the average size of particles found in it. It contains four different particles of varying sizes namely-

1. Gravel
2. Sand
3. Silt
4. Clay

Quality of soil is determined by the content of humus and microscopic organisms found in it.
The mineral nutrients that are found in a particular soil depend on the rocks it was formed from.
Humus is a major factor in deciding the soil structure because it causes the soil to become more porous and allows water and air to penetrate deep underground.

Factors that decide the type of plant that will thrive on a particular soil:

- The nutrient content of a soil,
- The amount of humus present in it
- The depth of the soil

Top soil: the topmost layer of the soil that contains humus and living organisms in addition to the soil particles is called the topsoil. The quality of the topsoil is an important factor that decides biodiversity in that area.

Soil pollution:

Removal of useful components from the soil and addition of harmful substances, which adversely affect the fertility of the soil and kill micro-organisms living in it, are called soil pollution. Fertilizers and pesticides destroy the soil structure. Mosses or Bryophytes are indicator of soil pollution.

Soil erosion:

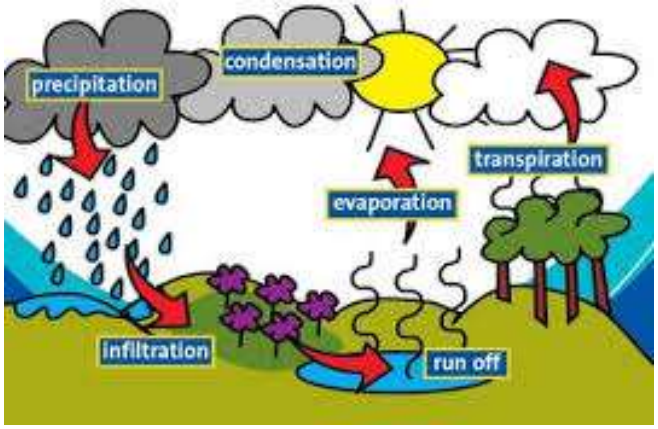
Removal of topmost layer of soil by wind, flowing water or other activities is called soil erosion. Roots of plants prevent soil erosion by firmly holding the soil particles.

Biogeochemical cycle:

A biogeochemical cycle is the flow of matter from non- living environment to the living organisms and its return back to the non-living environment.

THE WATER-CYCLE

The whole process in which water evaporates and falls on the land as rain and later flows back into the sea via rivers is known as the water-cycle.



The water cycle in nature is also known as hydrological cycle. The various steps involved in the water cycle in the biosphere are:

1. Evaporation:
Evaporation is when the sun heats up water in seas and oceans and turns it into water vapour or steam. The Sun's heat provides energy to evaporate water from the Earth's surface (oceans, lakes, etc.) and form water vapour which being lighter than air rises up and goes into the atmosphere.

2. Transpiration - The plants continuously absorb water from the soil through their roots. Some of this water is utilized by the plants for photosynthesis. The excess water in the body of plants is added to the atmosphere in the form of water vapour from the leaves of plants through the process of transpiration. The water vapours produced also goes into the atmosphere. Transpiration is the process by which plants and trees lose water out of their leaves into the air.

3. During the process of respiration in living plants and during the decay of dead plants water vapour is produced which also goes into the atmosphere.

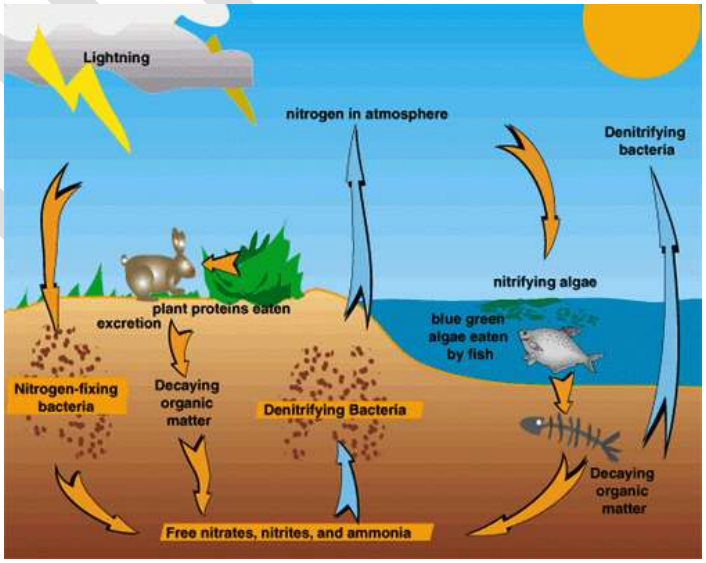
4. Condensation – As the water vapour rises up, it gets cooled and it eventually condenses back into tiny droplets of liquid water.

5. These droplets are small enough to float in the air and eventually collect together to make a cloud. These clouds can be blown by the wind to move water to different parts of the earth.

6. Precipitation - As more and more water droplets form, they will join together to form bigger water drops in the clouds. These drops become too heavy to stay in the air and will fall to the earth as rain. In case of extremely cold weather, the water might freeze and fall as hail or snow. Any water that falls from the sky- rain, snow, sleet or hail is called precipitation.

7. Percolation and absorption: Some of the precipitation soaks into the ground. Some of the underground water percolates through the rock or clay layers to reach the underground water. This is called groundwater. On land the water is used by the plants, crops and trees to grow. But most of the water flows downhill as runoff (above ground or underground), eventually returning to the seas as slightly salty water. In this way water was taken from the earth, returns to the earth and the water cycle is completed.

NITROGEN CYCLE:-



Nitrogen makes up seventy-eight percent of the atmosphere, but most organisms cannot use this form of nitrogen, and must have the fixed form. Nitrogen is also a part of many molecules essential to life like proteins, nucleic acids (DNA and RNA) and some vitamins. Nitrogen is found in other biologically important compounds such as alkaloids and urea too. Nitrogen is thus an essential nutrient for all life-forms and life would be simple if all these life-forms could use the atmospheric nitrogen directly. The nitrogen cycle produces the fixed form of nitrogen these organisms need.

Step 1-

Nitrogen Fixation–

By lightning– During lightning, the high temperatures and pressures created in the air convert nitrogen into oxides of nitrogen. These oxides dissolve in water to give nitric and nitrous acids and fall on land along with rain. These are then utilised by various lifeforms.

By bacteria– Molecular nitrogen is converted into nitrates and nitrites by free living bacteria or the bacteria like Rhizobium present in the root nodules of legumes. Special bacteria convert the nitrogen gas (N_2) to ammonia (NH_3) which the plants can use.

Step 2-

Nitrification– Nitrification is the process which converts the ammonia into nitrite ions and then into nitrates which the plants can take in as nutrients. Special kinds of bacteria are involved in this process which occurs naturally in the environment. The bacteria nitrosomonas and nitrococcus convert the ammonia into nitrite and then nitrobacter convert the nitrites into nitrates by oxidizing NO_2 to NO_3. All these bacteria reside in soil and are called as nitrifying bacteria. These soluble nitrates dissolve in soil water and are absorbed by the roots of plants. The nitrates and nitrites are used by plants to make amino acids which are then used to make plant proteins. The plant may be eaten by an animal, and its biomass used to produce **animal protein**.

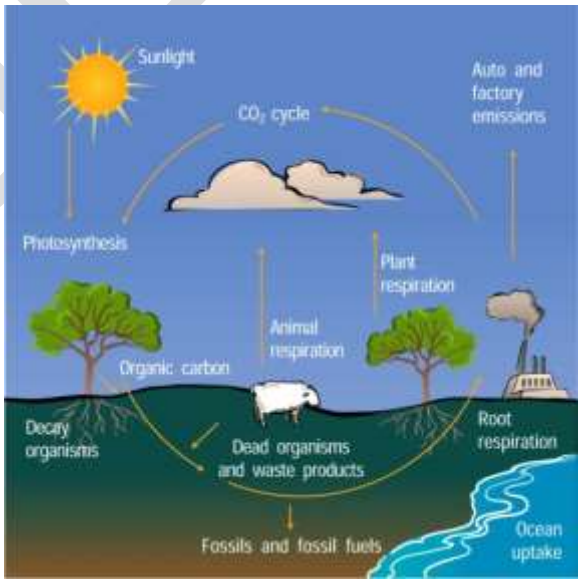
Step 3-

Ammonification– When an animal or plant dies they release wastes from their bodies, nitrogen is released in the organic form. This organic nitrogen is converted into ammonium by fungi and bacteria through the process Ammonification. After all of the living organisms have used the nitrogen, decomposer bacteria convert the nitrogen-rich waste compounds into simpler ones. Urea and egested material is broken down by decomposers. This results in nitrogen being returned to the soil as **ammonia**. Decomposers also break down the bodies of dead organisms resulting in nitrogen being returned to the soil as ammonia.

Step 4-

Denitrification- Denitrification is the final step in which the simple nitrogen compounds are converted back into nitrogen gas (N2), which is then released back into the atmosphere to begin the cycle again. When the ammonia is converted back into inert nitrogen, the process is called as denitrification. Bacteria are involved in this process which takes place in anaerobic conditions. Places like deep soils and deep water are the places without oxygen. Pseudomonas and Clostridium are responsible for the step of denitrification. These bacteria can also live in the places where there is availability of oxygen.

CARBON CYCLE:



Carbon is found in various forms on the Earth. It occurs in the elemental form as diamonds and graphite. In the combined state, it is found as carbon dioxide in the atmosphere, as carbonate and hydrogen carbonate salts in various minerals, while all life-forms are based on carbon-containing molecules like proteins, carbohydrates, fats, nitrogen-cycle in nature nucleic acids and vitamins. The endoskeletons and exoskeletons of various animals are also formed from carbonate salts.

The carbon cycle is the process by which carbon moves from the atmosphere into the Earth and its organisms and then back again.
Carbon enters the atmosphere as **carbon dioxide** from respiration (breathing) and combustion (burning)

Photosynthesis

Carbon is incorporated into life-forms through the basic process of photosynthesis which is performed in the presence of Sunlight by all life-forms that contain chlorophyll. This process converts carbon dioxide from the atmosphere or dissolved in water into glucose molecules. Plants store and use this sugar to grow and to reproduce. Thus, plants help to remove carbon from the atmosphere. When plants are eaten by animals, their carbon is passed on to those animals. Since animals cannot make their own food, they must get their carbon either directly by eating plants or indirectly by eating animals that have eaten plants.

At the same time that some processes of nature are removing carbon from the air, other processes are adding more carbon to the air.

Respiration: Respiration is the next step in the cycle, and it occurs in plants, animals, and even decomposers. When plants and animals respire, glucose stored in the plants and animals are broken down to release CO_2, water and energy. Through this process, CO_2 is released back into the atmosphere.

Decomposition: As plants and animals die and decay or decompose (or when animals defecate and their waste materials decompose), the carbon found in them are released to the environment. When the decaying matter bodies get buried under the ground and are subjected to high pressures and other physical and chemical changes for millions of years, they change into fossil fuels.

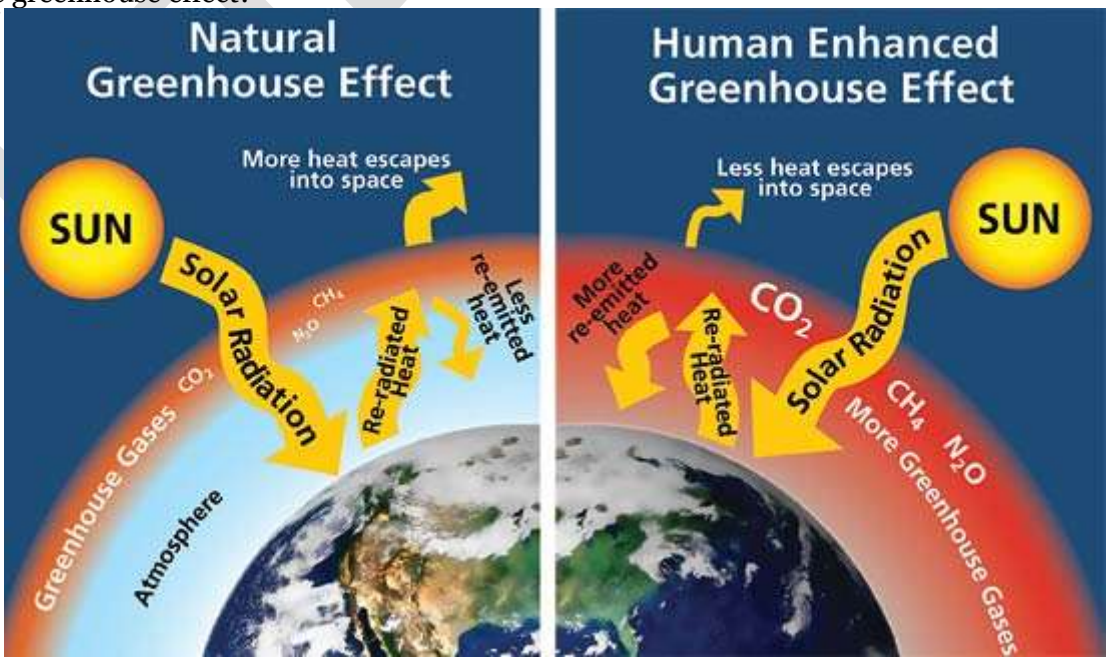
Combustion: When the fossil fuels are burnt to provide energy for various needs like heating, cooking, transportation and industrial processes most of the carbon rapidly enters the atmosphere as carbon dioxide gas. In fact, the percentage of carbon dioxide in the atmosphere is said to have doubled since the industrial revolution when human beings started burning fossil fuels on a very large scale.

Movement of carbon from the atmosphere to the oceans: The oceans, and other water bodies, soak up about a quarter of the carbon dioxide gas from the atmosphere. However, this uptake process is slow. Similarly, under normal conditions, the release of carbon dioxide back into the atmosphere from the ocean is also at a very low rate.

Through these steps the total amount of carbon in the environment remains constant. There is no formation or demolition of carbon in this process and it only involves the movement of this element from one form to another.

THE GREENHOUSE EFFECT

What is the greenhouse effect?



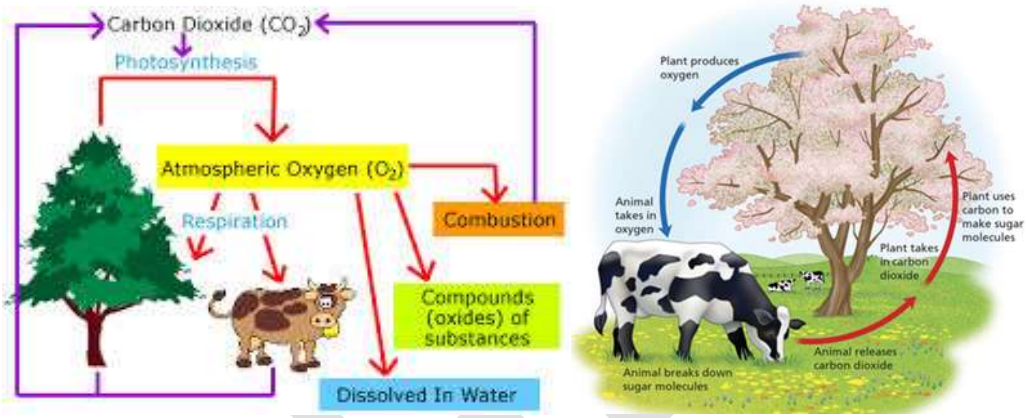
The definition of the greenhouse effect is the warming that results when heat is trapped. This process is similar to how the glass house (known as the greenhouse) works. The glass house traps the sun's heat energy within and maintains the temperature optimally warm for plants to grow.

Some gases prevent the escape of heat from the Earth. An increase in the percentage of such gases in the atmosphere would cause the average temperatures to increase worldwide and this is called the greenhouse effect. Carbon dioxide is one of the greenhouse gases. This means that it traps heat and prevents it from escaping from Earth. As a result, this trapped gas leads to a global temperature rise, a natural phenomenon known as the greenhouse effect, which can have disastrous effects on Earth's environment.

OXYGEN CYCLE

Oxygen is an important element to life on Earth. It is the most common element of the human body. It makes up about 65% of the mass of the human body. Most of this is in the form of water (H2O). Oxygen also makes up about 30% of the Earth and 20% of the atmosphere.

The Oxygen Cycle



Oxygen is constantly being used and created by different processes on planet Earth. All of these processes together make up the oxygen cycle. The oxygen cycle is interconnected with the carbon cycle.

Processes That Use Oxygen

- **Respiration**:

Animals take in simple sugars (glucose) and oxygen and release carbon dioxide, water and energy.

- **Decomposition**: Is a minor part of the Carbon/Oxygen cycle

Decomposition is when any **organic** matter (plants, animals) **breaks down chemically** into all the simple elements that they are made of and these elements return back to the environment.
As plants and animals die and decay or decompose (or when animals defecate and their waste materials decompose), the **carbon**, **oxygen**, nitrogen, water, calcium etc. return to the soil and air during decomposition.

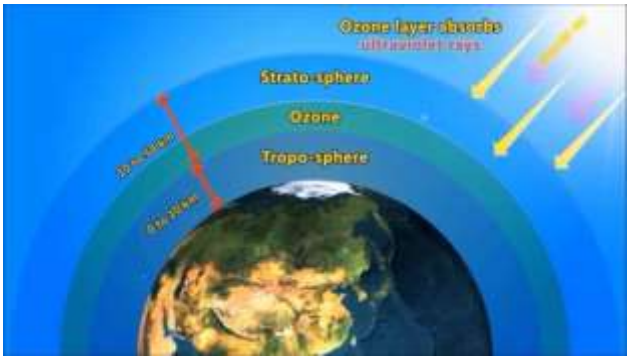
Processes That Produce Oxygen

- **Photosynthesis:**

Green plants/trees take in Carbon Dioxide and water using the chlorophyll in their leaves and energy from the sun they release Oxygen, sugar and water vapor.

- **Sunlight –** Some oxygen is produced when sunlight reacts with water vapor in the atmosphere.

Ozone Layer

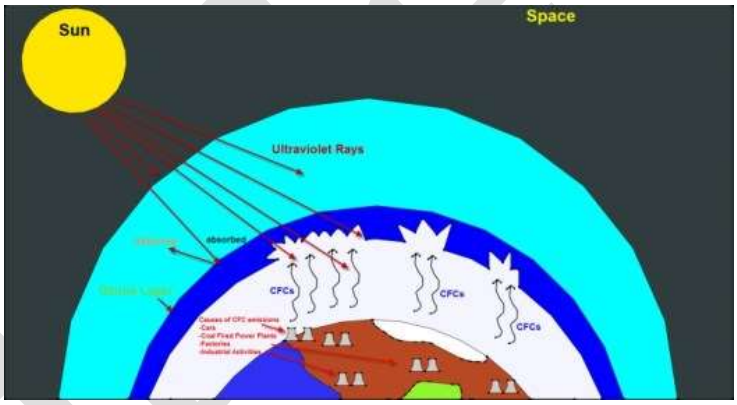


Elemental oxygen is normally found in the form of a diatomic molecule. However, in the upper reaches of the atmosphere, a molecule containing three atoms of oxygen is found. This would mean a formula of O3 and this is called ozone.

This is simply a layer in the stratosphere containing a relatively high concentration of ozone. The ozone layer is mainly found in the lower portion of the stratosphere from approximately 20 to 30 kilometers (12 to 19 mi) above earth, though the thickness varies seasonally and geographically.

Ozone is poisonous and it is not stable nearer to the Earth's surface. But, it performs an essential function where it is found. It absorbs harmful radiations from the Sun. This prevents those harmful radiations from reaching the surface of the Earth where they may damage many forms of life.

Depletion of ozone layer:



Ozone layer depletion is simply the reduction of the amount of ozone in the stratosphere. Ozone depletion is caused because of one the industries that manufacture things like insulating foams, solvents, soaps, cooling things like Air Conditioners, and Refrigerators that use chlorofluorocarbons (CFCs). Depletion begins when CFC's get into the stratosphere. Ultra violet radiation from the sun breaks up these CFCs. The breaking up action releases Chlorine atoms. Chlorine atoms react with Ozone, starting a chemical cycle that destroys the good ozone in that area. One chlorine atom can break apart more than 100,000 ozone molecules.