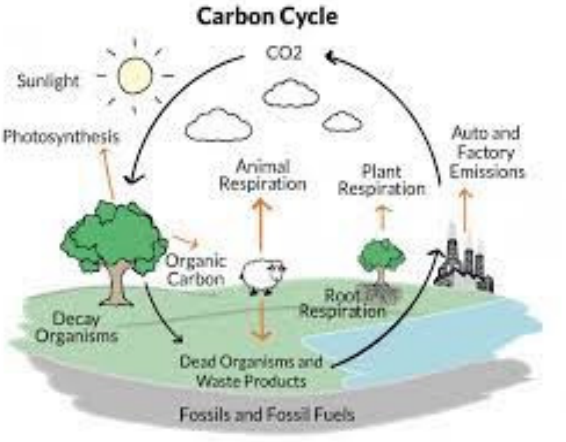
## 1. Carbon Cycle:

The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. It is one of the most important cycles of the earth and allows for carbon to be recycled and reused throughout the biosphere and all of its organisms.

The Carbon Cycle is a complex series of processes through which all of the carbon atoms in existence rotate. The wood burned just a few decades ago could have produced carbon dioxide which through photosynthesis became part of a plant. When you eat that plant, the same carbon from the wood which was burnt can become part of you. The carbon cycle is the great natural recycler of carbon atoms.

Without the proper functioning of the carbon cycle, every aspect of life could be changed dramatically. Plants, animals, and soil interact to make up the basic cycles of nature. In the carbon cycle, plants absorb carbon dioxide from the atmosphere and use it, combined with water they get from the soil, to make the substances they need for growth. The process of photosynthesis incorporates the carbon atoms from carbon dioxide into sugars.



Animals, such as the rabbit eat the plants and use the carbon to build their own tissues. Other animals, such as the fox, eat the rabbit and then use the carbon for their own needs. These animals return carbon dioxide into the air when they breathe, and when they die, since the carbon is returned to the soil during decomposition. The carbon atoms in soil may then be used in a new plant or small microorganisms. The following major reservoirs of carbon interconnected by pathways of exchange:

i. The atmosphere.

ii. ii. The terrestrial biosphere, which is usually defined to include fresh water systems and non-living organic material, such as soil carbon.

iii. iii. The oceans, including dissolved inorganic carbon and living and non-living marine biota.

iv. iv. The sediments including fossil fuels

v. v. The Earth's interior, carbon from the Earth's mantle and crust is released to the atmosphere and hydrosphere by volcanoes and geothermal systems.

The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest active pool of carbon near the surface of the Earth, but the deep ocean part of this pool does not rapidly exchange with the atmosphere in the absence of an external influence, such as an uncontrolled deep-water oil well leak.

The global carbon budget is the balance of the exchanges (incomes and losses) of carbon between the carbon reservoirs or between one specific loop the carbon cycle.

**Carbon is released into the atmosphere in several ways:**

i. Through the respiration performed by plants and animals. This is an exothermic reaction and it involves the breaking down of glucose (or other organic molecules) into carbon dioxide and water.

ii. Through the decay of animal and plant matter. Fungi and bacteria break down the carbon compounds in dead animals and plants and convert the carbon to carbon dioxide if oxygen is present, or methane if not.

iii. Through combustion of organic material which oxidizes the carbon it contains, producing carbon dioxide (and other things, like water vapour). Burning fossil fuels such as coal, petroleum products releases carbon dioxide. Burning agro fuels also releases carbon dioxide

iv. Volcanic eruptions and metamorphism release gases into the atmosphere. Volcanic gases are primarily water vapour, carbon dioxide and sulphur dioxide.

v. Carbon is transferred within the biosphere as heterotrophs feed on other organisms or their parts (e.g., fruits). This includes the uptake of dead organic material (detritus) by fungi and bacteria for fermentation or decay.

vi. Most carbon leaves the biosphere through respiration. When oxygen is present, aerobic respiration occurs, which releases carbon dioxide into the surrounding air or water, following the reaction $C_6H_{12}O_6 + 60_2 \longrightarrow 6CO_2 + 6H_2O$. Otherwise, anaerobic respiration occurs and releases methane into the surrounding

environment, which eventually makes its way into the atmosphere or hydrosphere (e.g., as marsh gas or flatulence).

**Circulation of carbon dioxide:**

i. Plants absorbs the carbon dioxide from the atmosphere.

ii. During the process of photosynthesis, plants incorporates the carbon atoms from carbon dioxide into sugars.

iii. Animals, such as the rabbit eat the plants and use the carbon to build their own tissues, chain the carbon content.

iv. Through the food chain, carbon is transferred into foxes, lions etc.

v. The animals return carbon dioxide into the air when they breathe, and when they die, since the carbon is returned to the soil during decomposition.

***In Case of Ocean:***

In regions of oceanic upwelling, carbon is released to the atmosphere. Conversely, regions of down welling transfer carbon ($CO_2$) from the atmosphere to the ocean. When $CO_2$ enters the ocean, it participates in a series of reactions which are locally in equilibrium:

i. Conversion of $CO_2$ (atmospheric) to $CO_2$ (dissolved).

ii. Conversion of $CO_2$ (dissolved) to carbonic acid ($H_2CO_3$).

iii. Conversion of carbonic acid ($H_2CO_3$) to bicarbonate ion.

iv. Conversion of bicarbonate ion to carbonate ion.

In the oceans, dissolved carbonate can combine with dissolved calcium to precipitate solid calcium carbonate, $CaCO_3$, mostly as the shells of microscopic organisms. When these organisms die, their shells sink and accumulate on the

ocean floor. Over time these carbonate sediments form limestone which is the largest reservoir of carbon in the carbon cycle.

The dissolved calcium in the oceans comes from the chemical weathering of calcium-silicate rocks, during which carbonic and other acids in groundwater react with calcium-bearing minerals liberating calcium ions to solution and leaving behind a residue of newly formed aluminium-rich clay minerals and insoluble minerals such as quartz.

The flux or absorption of carbon dioxide into the world's oceans is influenced by the presence of widespread viruses within ocean water that infect many species of bacteria. The resulting bacterial deaths spawn a sequence of events that lead to greatly enlarged respiration of carbon dioxide, enhancing the role of the oceans as a carbon sink.