1. NUTRIENT CYCLING

- The movement of nutrient elements through the various components of an ecosystem is called **nutrient cycling**. Another name of nutrient cycling is **biogeochemical** cycles (bio: living organism, geo: rocks, air, water).

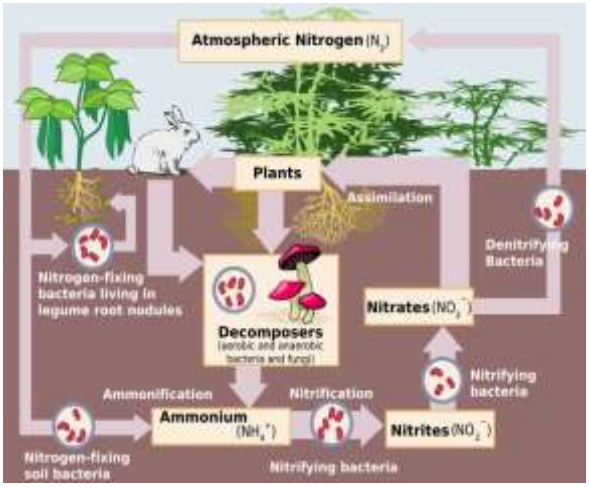
Biogeochemical Cycle

A constant interaction between the biotic and abiotic components, make it a dynamic, but stable system. These interactions consist of a transfer of matter and energy between different components. E.g. Water cycle- from water to vapour (evaporation), from vapour to water (condensation).

Classification of Cycles

a) Nutrient cycles are of two types: (a) **gaseous** and (b) **sedimentary.**
b) **Atmosphere** acts as the reservoir for gaseous type of nutrient cycle.
   i. Nitrogen cycle, ii. Carbon cycle
c) **Earth's crust** acts as the reservoir for the sedimentary cycle.
   i. Sulphur cycle,
   ii. Phosphorus cycle
d) Environmental factors, e.g., **soil, moisture, pH, temperature**, etc., regulate the rate of release of nutrients into the atmosphere.

1. NITROGEN CYCLE



- Nitrogen gas makes up 78% of our atmosphere and nitrogen is also a part of many molecules essential to life like **proteins**, **nucleic acids** (DNA and RNA) and **some vitamins** and found in other alkaloids and urea too.
- All the life-forms could not use the atmospheric nitrogen directly.
- Only few forms of bacteria are able to convert the comparatively inert **nitrogen** molecule into forms like **nitrates** and **nitrites** which can be taken up and used to make the required molecules.
- These 'nitrogen-fixing' bacteria most commonly, found in the roots of legumes (generally the plants which give us pulses) in special structures called **root nodules**.
- Other than these bacteria, the only other manner in which the nitrogen molecule is converted to nitrates and nitrites is by a physical process.

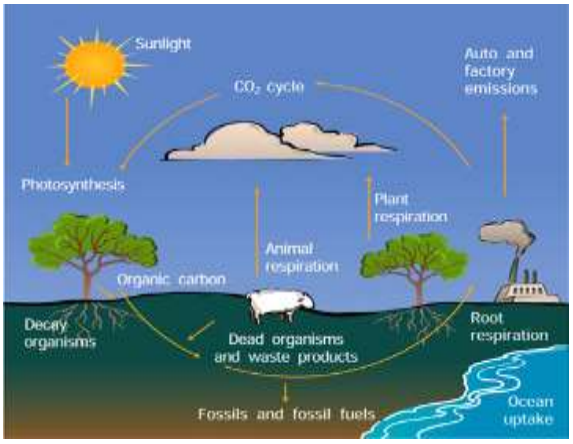
Process Involved

- Nitrogen cycle involves the following important processes- Fixation, Ammonification, Nitrification and denitrification.
- **Fixation:** 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 life forms.
- **Ammonification:** Plants generally take up nitrates and nitrites and convert them into **amino acids** which are used to make proteins. These proteins and other complex compounds are subsequently consumed by animals.
- **Nitrification**: Once the animal or the plant dies, other bacteria in the soil convert the various compounds of nitrogen back into **nitrates** and **nitrites**.

- **Denitrification:** A different type of bacteria converts the nitrates and nitrites into elemental **nitrogen**.
- Thus, there is a nitrogen-cycle in nature in which nitrogen passes from its elemental form in the atmosphere into simple molecules in the soil and water, which get converted to more complex molecules in living beings and back again to the simple nitrogen molecule in the atmosphere.
- The amount of nitrogen released due to manmade (industrial) activities disrupt the cycle of nitrogen and leading to **acid rain, algal bloom** and **eutrophication**.

- **Nitrogen fixing bacteria/micro organisms**
- **Rhizobium**-symbiotic micro-organism present in root nodules of Leguminous plants.
- **Azotobacter**-aerobic, Clostridium-anaerobic- both are nitrifying bacteria.
- **Acetobacter**-live inside plant tissue. It can survive in high sugar content.
- **Azolla**- aquatic fern. Symbiotic relationship with Blue green algae.
- **Blue green Algae**- e.g. Anabaena, spirulina fixes nitrogen
- **Cyanobacteria**- fixes nitrogen
- **Nostoc**-also increases water holding capacity and used as feed for cattle and poultry.

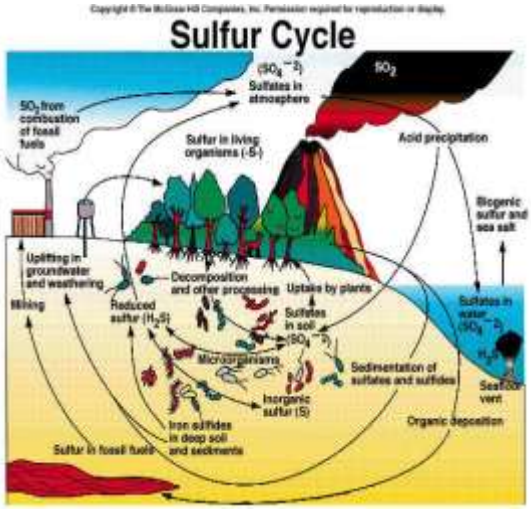
2. CARBON CYCLE



- Carbon constitutes the 49 per cent of dry weight of living organisms and is next only to water. **71 per cent** of global carbon is found **dissolved in oceans.**
- This oceanic reservoir regulates the amount of carbon dioxide in the atmosphere. The atmosphere only contains about 1per cent of total global carbon. Fossil fuel also represents a reservoir of carbon.
- Carbon cycling occurs through atmosphere, ocean and through living and dead organisms. A considerable **amount of carbon returns to the atmosphere** as CO_2 through **respiratory activities** of the producers and consumers.
- Decomposers also contribute substantially to CO_2 pool by their processing of waste materials and dead organic matter of land or oceans. Some amount of the fixed carbon is lost to sediments and removed from circulation.
- **Burning of wood**, **forest fire** and **combustion of organic matter**, **fossil fuel**, **volcanic activity, hot spring, geyser, dissolution of carbonate rocks (limestone)** are additional **sources** for releasing **CO_2** in the atmosphere.
- Human activities have significantly influenced the carbon cycle.

- Rapid deforestation and massive burning of fossil fuel for energy and transport have significantly increased the rate of release of carbon dioxide into the atmosphere (greenhouse effect).

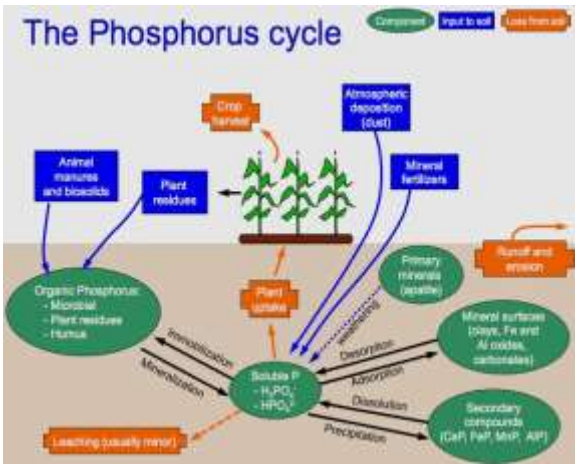
3. SULPHUR CYCLE



- Sulphur enters the atmosphere from several sources like volcanic eruptions, combustion of fossil fuels, from surface of ocean and from gases released during decomposition.
- Sulphur in the form of **sulphates** is taken up by plants and converted to **sulphur bearing amino acid** through various metabolic process and then incorporated to proteins of autotroph tissues. It then passes through grazing food chain.
- Sulphur bound in living organisms is carried back to the soil, to the bottom of ponds and lakes and seas through excretion and decomposition of dead organic matter.

4. PHOSPHORUS CYCLE

1. Phosphorus is a major constituent of **biological membranes, nucleic acids and cellular energy transfer systems** and also present in **DNA, ATP and cell membranes.**



2. Many animals also need large quantities of this phosphorous to make **shells, bones** and **teeth.**
3. The natural reservoir of phosphorus is **rock**, which contains phosphorus in the form of **phosphates**.
4. When rocks are weathered, minute amounts of these phosphates dissolve in soil solution and are absorbed by the roots of the plants.
5. Herbivores and other animals obtain this element from plants.
6. The waste products and the dead organisms are decomposed by phosphate-solubilising bacteria releasing phosphorus.
7. Atmospheric inputs of phosphorus through rainfall are much smaller than carbon inputs, and, secondly, **gaseous exchanges of phosphorus between organism and environment are negligible**.
8. Mycorrhizal fungi- release oxalic acid into the soil, thereby maintaining phosphorous content.