The Nitrogen Cycle : (make up 78% of the atmosphere).

Nitrogen is essential to life because it is a key component of proteins and nucleic acids. Nitrogen occurs in many forms and is continuously cycled among these forms by a variety of bacteria .

Why the nitrogen cycle is complex?

The cycling of nitrogen among its many forms is a complex process that involves numerous types of bacteria and environmental conditions.

In general, the nitrogen cycle has five steps :

1- Nitrogen fixation (N_2 to NH_3/ NH_4^+ or NO_3)

Nitrogen fixation is the process by which gaseous nitrogen (N_2) is converted to ammonia (NH_3 or NH_4^+) via biological fixation (bacteria) or nitrate (NO_3^-) through high-energy physical processes (physical fixation). N_2 can be converted directly into NO_3^- through processes include combustion, volcanic action and lightning discharges.

2- Nitrification (NH_3 to NO_3^-)
   Nitrification is a two-step process in which NH_3/ NH_4^+ is converted to NO_3^-. First, the soil bacteria *Nitrosomonas* and *Nitrococcus* convert NH_3 to NO_2^-, and then another soil bacterium, *Nitrobacter*, oxidizes NO_2^- to NO_3^-. These bacteria gain energy through these conversions, both of which require oxygen to occur.
3- Assimilation (Incorporation of NH_3 and NO_3^- into biological tissues)

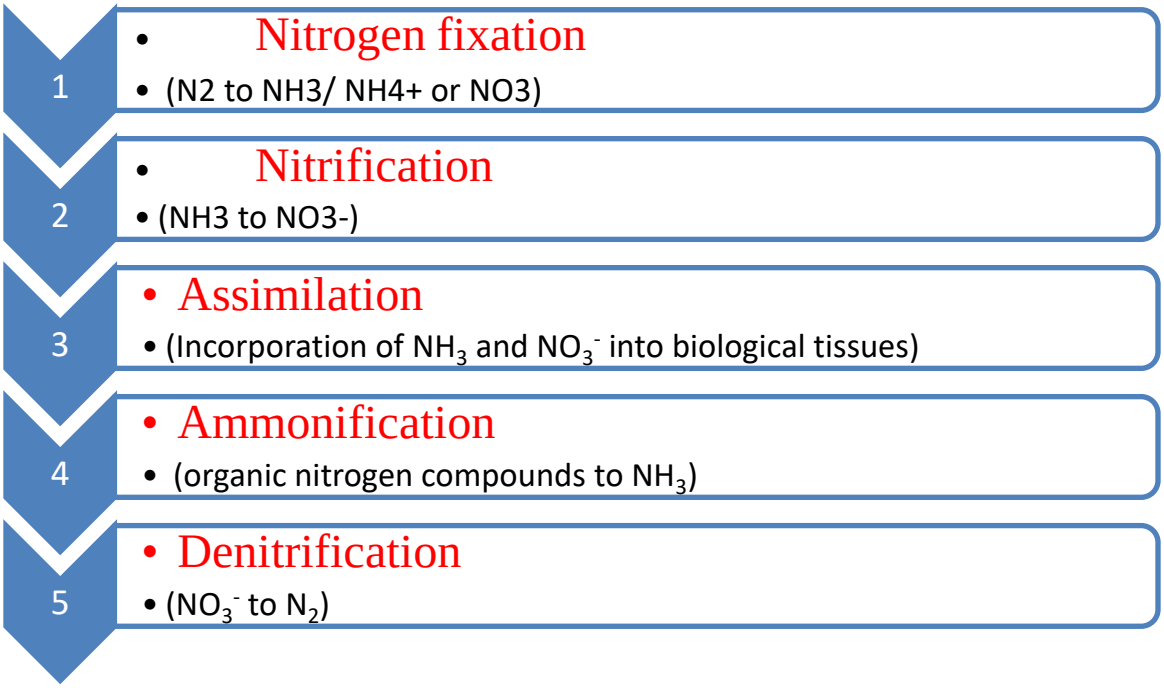
Plants take up these forms of nitrogen (the NO3- and ammonia formed through nitrogen fixation and nitrification) through their roots, and incorporate them into plant proteins and nucleic acids. Animals are then able to utilize nitrogen from the plant tissues.

4- Ammonification (organic nitrogen compounds to NH_3)

Assimilation produces large quantities of organic nitrogen, including proteins, amino acids, and nucleic acids. Ammonification is the conversion of organic nitrogen into ammonia. The ammonia produced by this process is excreted into the environment and is then available for either nitrification or assimilation.

5- Denitrification(NO_3^- to N_2)

Denitrification is the reduction of NO_3^- to gaseous N2 by anaerobic bacteria (*Pseudomonas*). This process only occurs where there is little to no oxygen, such as deep in the soil



((Five steps of Nitrogen cycle))

Phosphorus cycle

Phosphorus is a chemical element found on Earth in numerous compound forms, such as the phosphate ion (PO_4^{3-}), located in water, soil and sediments.
The quantities of phosphorus in soil are generally small, and this often limits plant growth. That is why people often apply phosphate fertilisers on farmland. Animals absorb phosphates by eating plants .

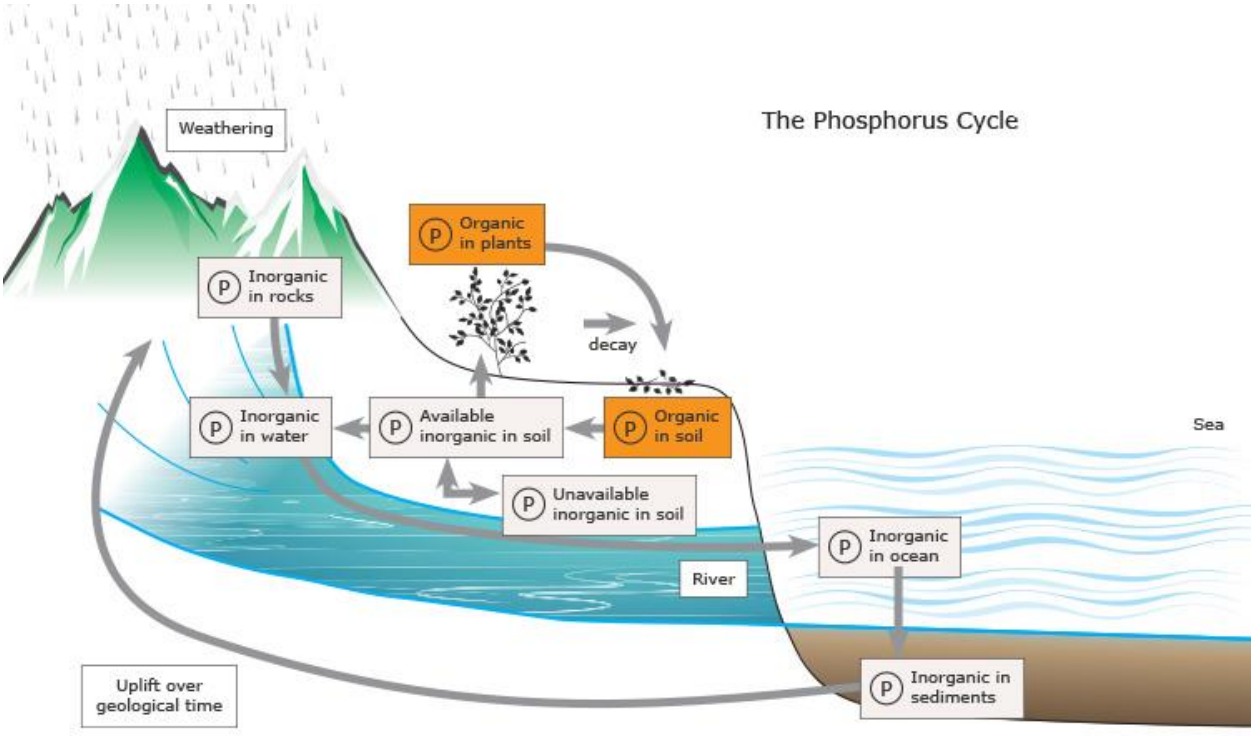
The role of phosphorus in animals and plants

Phosphorus is an essential nutrient for animals and plants.

1- It plays a critical role in cell development (Structure protoplasm and cell membranes)
2- It is a key component of molecules that store energy, such as ATP (adenosine triphosphate), DNA and lipids (fats and oils).
3- Insufficient phosphorus in the soil can result in a decreased crop yield.

Key steps of the phosphorus cycle:

1- Over time, rain and weathering cause rocks to release phosphate ions and other minerals. This inorganic phosphate is then distributed in soils and water.
2- Plants take up inorganic phosphate from the soil. The plants may then be consumed by animals. Once in the plant or animal, the phosphate is incorporated into organic molecules such as DNA. When the plant or animal dies, it decays, and the organic phosphate is returned to the soil.
3- In soil , mineralization can occur by converting organic forms of phosphate into inorganic forms of phosphate by bacteria .
4- Phosphorous in soil can end up in waterways and eventually oceans , it can be incorporated into sediments over time .



Q / Definition of eutrophication

the process by which a body of water becomes enriched in dissolved nutrients (such as phosphates comes from detergent) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen

Sulphur cycle :

The importance of sulfur is that it is an essential element in the construction of many proteins, and is used in the activation of some enzymes and in the detoxification reactions of the body, and in nature there is sulfur in the form of hydrogen sulfide H2S and elemental sulfur S and SO4 sulfate. Sulfur comes from several sources, including :

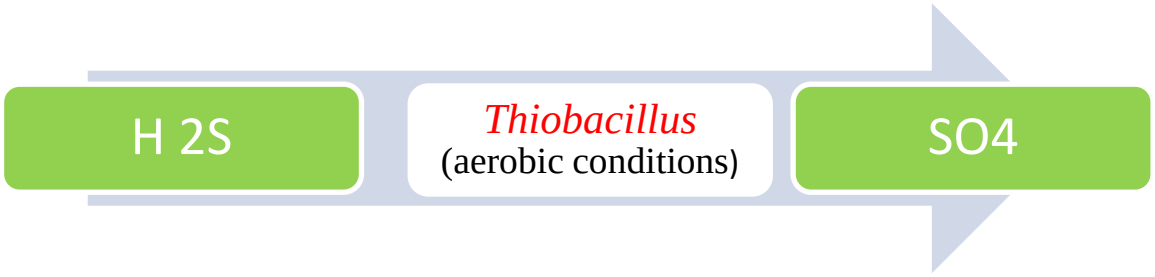
1- The decomposition of organic matter in the soil by bacteria, where hydrogen sulfide, which is then oxidized, is transformed into ammonium sulfate by oxidizing bacteria.

2 - Air erosion of some rocks containing sulfur

3 - Volcanoes where sulfur gases are released from the ground

4- Industrial pollution: factories and cars release sulfur dioxide gas into the atmosphere and fall with rain water in the form of drops of dilute sulfuric acid, forming what is known as acid rain Acidic rain where they affect the land vegetation, acid rain may reach ponds and lakes to affect life Fish and aquatic organisms.

In aerobic conditions, organic sulfur decomposes into H2S, where it is oxidized to SO4 by the oxidizing bacteria *Thiobacillus* to obtain energy and the SO4 is re-used by products.



Anaerobic conditions may return and the SO4 is reduced by the reducing bacteria of *Sporovibrio* as follows

Note

Magnesium is an important component in the synthesis of the chlorophyll molecule