Department of biology

2025-2026

((Ecology))

Stage (-3-)

LEC- ((8))

Ecosystem function– Biogeochemical cycles (cycling of nutrients in ecosystem)

By

Prof. Dr. Dhurgham Ali Al-Sultany

Second \\ Nitrogen cycle

Nitrogen is an essential component of protein and required by all living organisms including human beings.

Our atmosphere contains nearly 79% of nitrogen but it can not be used directly by the majority of living organisms. Broadly like carbon dioxide, nitrogen also cycles from gaseous phase to solid phase then back to gaseous phase through the activity of a wide variety of organisms. Cycling of nitrogen is vitally important for all living organisms. There are five main processes which essential for nitrogen cycle are elaborated below.

(a) **Nitrogen fixation:** This process involves conversion of gaseous nitrogen into Ammonia, a form in which it can be used by plants. Atmospheric nitrogen can be fixed by the following three methods:-

(i) **Atmospheric fixation**: Lightening, combustion and volcanic activity help in the fixation of nitrogen.

(ii) **Industrial fixation**: At high temperature (400oC) and high pressure (200 atm.), molecular nitrogen is broken into atomic nitrogen which then combines with hydrogen to form ammonia.

(iii) **Bacterial fixation**: There are two types of bacteria-

(i) Symbiotic bacteria e.g. Rhizobium in the root nodules of leguminous plants.

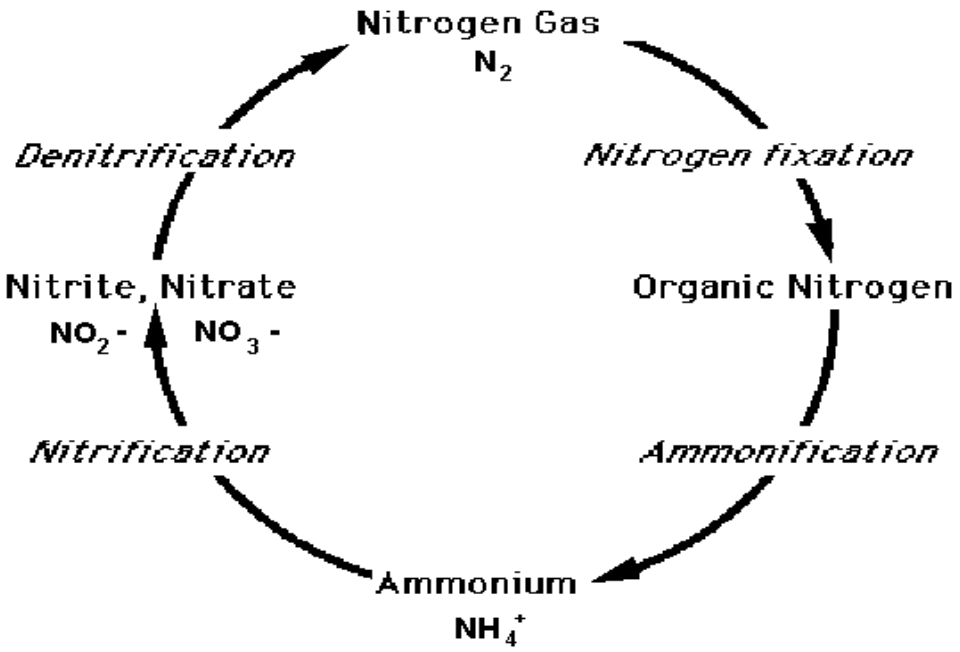
(ii) Free living or symbiotic e.g. 1. *Nostoc* 2. *Azobacter* 3. Cyanobacteria can combine atmospheric or dissolved nitrogen with hydrogen to form ammonia.

(b) **Nitrification:** It is a process by which ammonia is converted into nitrates or nitrites by *Nitrosomonas* and *Nitrococcus* bacteria respectively. Another soil bacteria *Nitrobacter* can covert nitrate into nitrite.

(c) **Assimilation:** In this process nitrogen fixed by plants is converted into organic molecules such as proteins, DNA, RNA etc. These molecules make the plant and animal tissue.

(d) **Ammonification** : Living organisms produce nitrogenous waste products such as urea and uric acid. These waste products as well as dead remains of organisms are converted back into inorganic ammonia by the bacteria This process is called ammonification. Ammonifying bacteria help in this process.

(e) **Denitrification:** Conversion of nitrates back into gaseous nitrogen is called denitrification. Denitrifying bacteria live deep in soil near the water table as they like to live in oxygen free medium. Denitrification is reverse of nitrogen fixation.



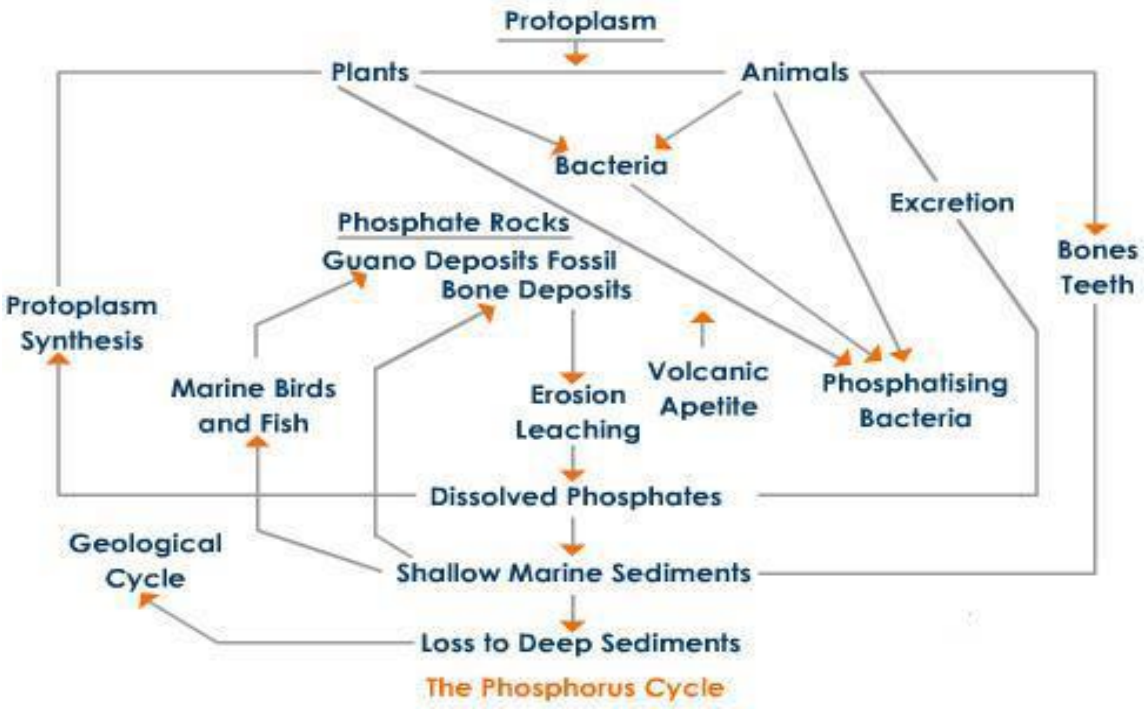
Third \\ Sedimentary cycles

Usually the elements that contain in sedimentary cycle ended in milestones and then release with slowly transport, and is very difficult to close the cycle , so called **incomplete cycles**, while the elements in

gaseous cycles and water cycle transport easy ,so it can considerable **complete cycles**.

Forth \\ Phosphorus cycle

Phosphorus is an essential mineral nutrient for all plants and animals. Phosphorus forms the ions the of phosphates and hydrogen phosphates. These phosphates are important parts of DNA molecules and are also a part of energy storing molecules like the ATP and ADP and also fat molecules of the cell membranes. Phosphorus is also a building block of certain parts like bones and teeth in humans and animals. Phosphorus occurs most abundantly in nature as part of the orthophosphate ion $(PO_4)^{3-}$, consisting of a P atom and 4 oxygen atoms. On land most phosphorus is found in rocks and minerals.



Phosphorus is found in water, soil and sediments, it cannot be found in air in the gaseous state like other compounds of matter cycles. It is found mainly cycling through soil, sediments and water. The phosphorus cycle

is the slowest of the biogeochemical cycles. Phosphorus enters the environment from rocks and from deposits. Phosphate rock is commercially known as **apatite** and other **deposits from the fossilized bone or bird droppings**. Weathering of rocks releases phosphorus as ions which are soluble in water. Terrestrial plants need phosphate as fertilizers in the form of nutrients. Human influences on the phosphate cycle come mainly from the introduction and use of commercial synthetic fertilizers. The phosphate is obtained through mining of certain deposits of calcium phosphate called apatite. Huge quantities of sulfuric acid are used in the conversion of the phosphate rock into a fertilizer product called "super phosphate". Other human sources of phosphate are in the out flows from municipal sewage treatment plants. Without an expensive tertiary treatment, the phosphate in sewage is not removed during various treatment operations. Again an extra amount of phosphate enters the water.