NUTRIENT CYCLES

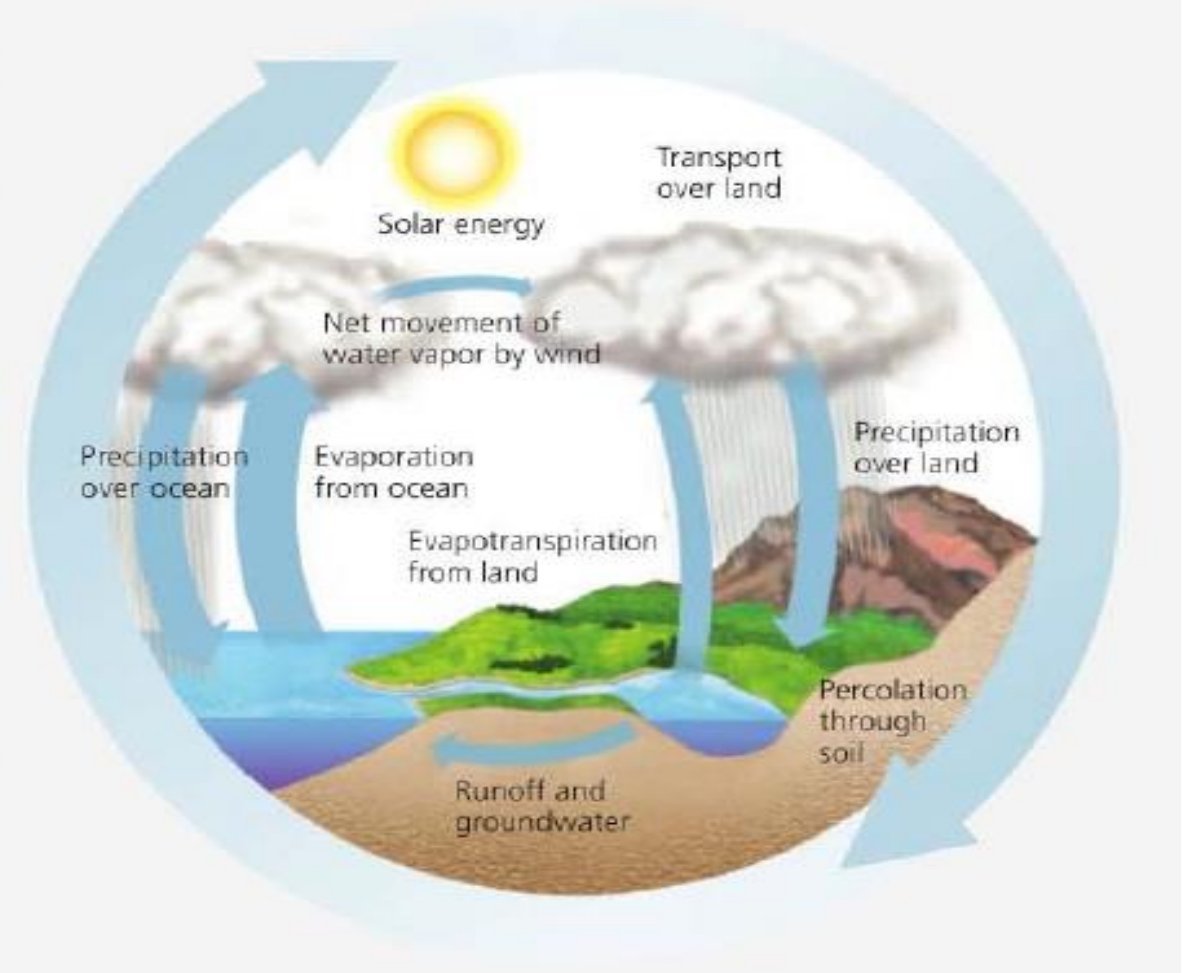
This refers to any of the various chemical cycles, which involve the interaction of both living and non living components of the environment.

The most common nutrient cycles include; the water cycle, nitrogen cycle and the carbon cycle.

THE WATER CYCLE

Water is essential to all organisms and its availability influences all process in the environment. Water is mostly used as liquid water although some organisms can utilise water vapour. Oceans contain 97% of the earth's water, 2% is found in ice caps and the remaining 1% is found in lakes, rivers and ground water, with a negligible amount in the atmosphere.

The main processes driving the water cycle are evaporation of liquid water by solar energy, condesation of liquid water into clouds, and rainfall (precipitation). Transpiration by terrestrial plants also moves significant voulmes of water into the atmosphere. Surface and groundwater flowcan return water to the oceans, completing the water cycle



THE CARBON CYCLE

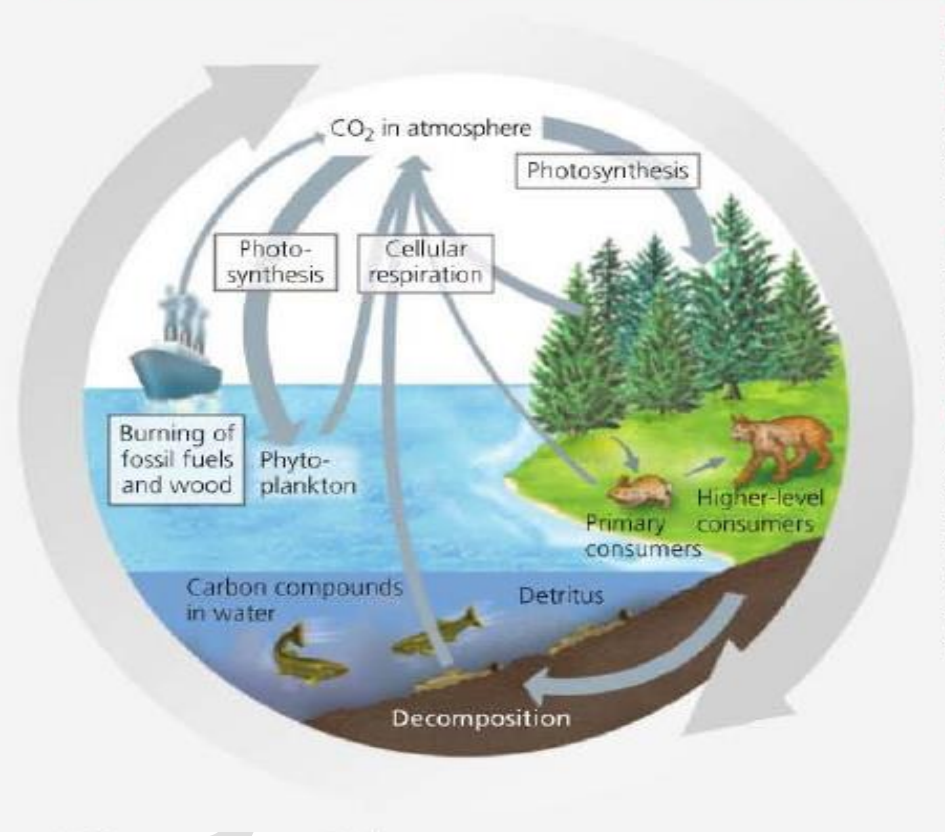
Carbon forms the framework of the organic molecules essential to all organisms.

Photosynthetic organisms use carbon dioxide during photosynthesis and convert the carbon to organic forms that are used by other organisms which feed on these photosynthetic organisms

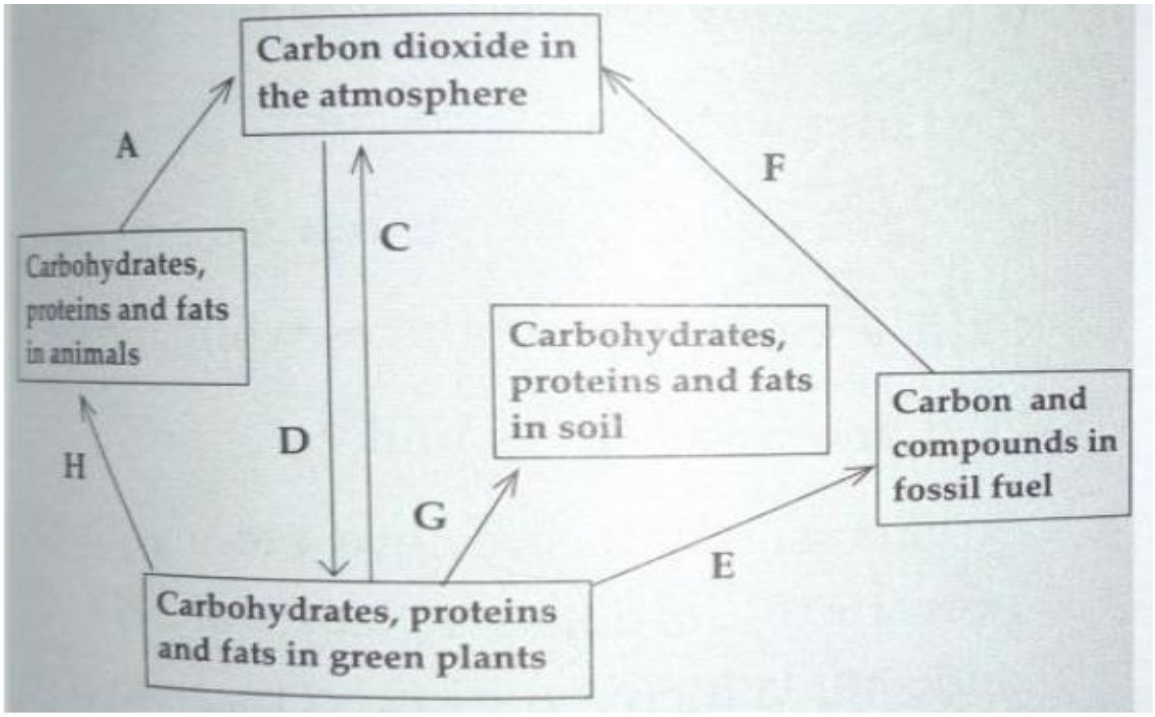
The major reservoirs of carbon include atmospheric carbon dioxide, fossil fuels, soils, dissolved carbon compounds, plant and animal biomass.

The air contains 0.03% carbon dioxide. When plants and phytoplanktons **photosynthesise,** carbon atoms from carbon dioxide become part of glucose or starch molecules in the plant or phytoplankton. Some of the glucose will be broken down by the plant in **respiration**.

The carbon in the glucose becomes part of a carbondioxide molecule again, and is released back into the air. Some of the carbon in the plant will be eaten by animals. The animals respire, releasing some of the carbon back into the air as carbon dioxide. When the plant or animal dies, decomposers will feed on them. The carbon becomes part of the decomposers' bodies. When they respire, they release carbon dioxide into the air again.



1.The figure below represents the carbon cycle. Study it and answer the questions that follow.



(a)Name the process labelled **A, C, F**, and **G**.
(b) State one physical factor that promotes process **D**.
(c.) Give two uses of process **D** to animals.
(d) Describe one way in which process E may be harmful.
(e) (i) Suggest **one** human activity that tends to lower the level of carbon dioxide in the atmosphere.
(ii) Explain how the activity suggested in e(i) lowers the level of carbon dioxide in the atmosphere.
2. Which of the stores carbon for the longest period in the carbon cycle.
A. Animals B. Plants C. Fossils D. Atmosphere

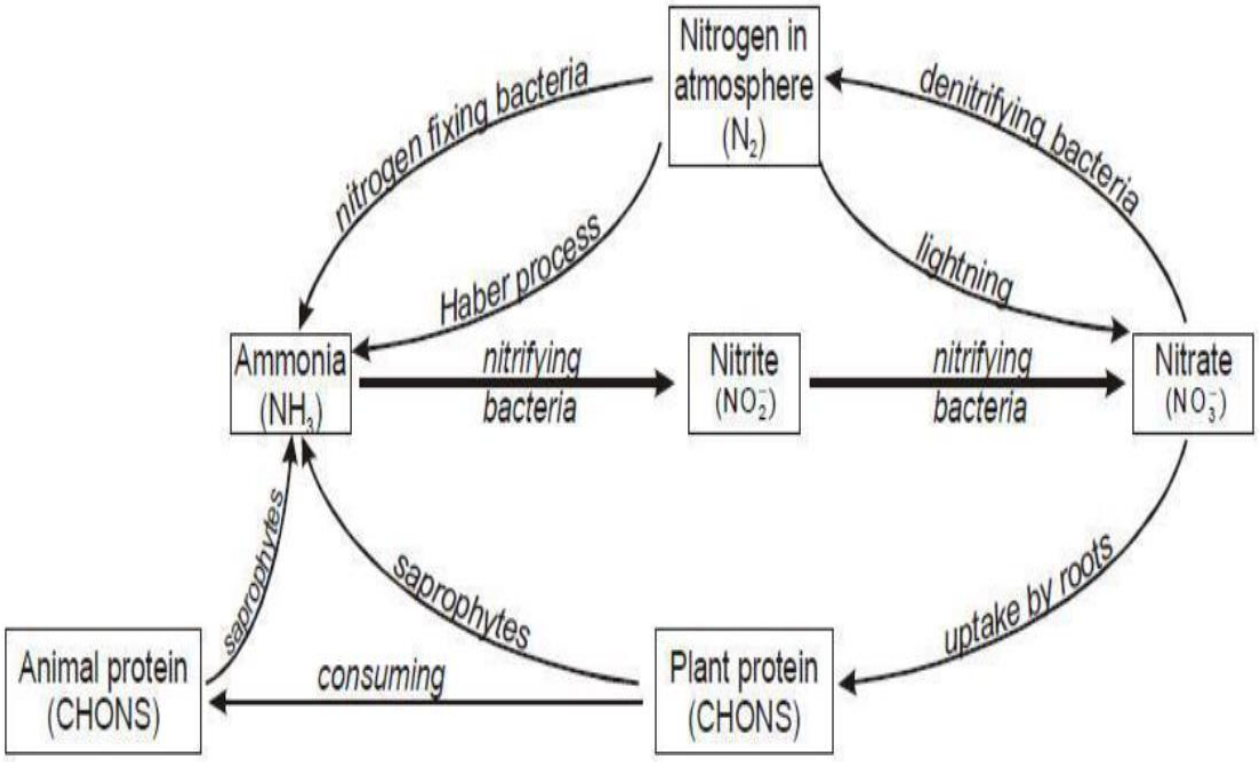
THE NITROGEN CYCLE

Nitrogen is part of amino acids, proteins, and nucleic acids and is often a limiting plant nutrient.

Plants can use two inorganic forms of nitrogen –ammonium (NH_4^+) and nitrate (NO_3^-) and some organic forms, such as amino acids. Various bacteria can use all of these forms as well as nitrite (NO_2^-). Animals can only use organic forms of nitrogen.

The major reservoir of nitrogen is the atmosphere, which is 80% nitrogen gas (N_2). The other reservoirs are soils and particles within rivers, lakes and oceans, dissolved nitrogen in surface water and ground water and the biomass of living organisms.

Although the air is full of nitrogen, it is an unreactive form that plants and animals cannot use it at all. It must first be changed into a more reactive form, such as ammonia (NH_3) or nitrates (NO_3^-). Changing nitrogen gas into a more reactive form is called **nitrogen fixation**. There are several ways that it can happen;



i. **Lightening.** Lightening makes some of the nitrogen gas in the air to combine with oxygen, forming nitrogen oxides. They dissolve in rain, and are washed into the soil, where they form nitrates.

ii. **Artificial fertilisers.** Nitrogen and hydrogen can be made to react in an industrial chemical process (Harber's process), forming ammonia. The ammonia is used to make ammonium compounds and nitrates, which are sold as fertilisers. A good fertiliser is one that contains a higher percentage of nitrogen.

iii. **Nitrogen fixing bacteria.** These bacteria live in the soil, or in root nodules (small swellings) on plants like peas and beans e.g. Rhizobium. They use nitrogen gas from the air spaces in the soil, and combine it with other substances to make nitrates and other compounds.

Once nitrogen has been fixed, it can be absorbed by roots of plants, and used to make proteins. When an animal or plant dies, bacteria and fungi decompose the bodies. The protein, containing nitrogen, is broken down to ammonia and this is released. Another group of bacteria, called **nitrifying bacteria**, turns the ammonia to nitrates, which the plants can use again. Nitrogen is also returned to the soil when animals excrete nitrogenous waste materials. It may be in the form of ammonia or urea. Again nitrifying bacteria will convert it to nitrates.

A third group of bacteria complete the nitrogen cycle. They are called **denitrifying bacteria** and turn nitrates and ammonia in the soil into nitrogen gas, which goes into the atmosphere. Most of the denitrifying bacteria are anaerobic bacteria found in water-logged soil, sewage, compost heaps and also occur naturally in soil.

NOTE:

1. **Carnivorous plants.** These stay in nitrogen deficient soils. If the soil is water logged, nitrogen fixing bacteria cannot live there, but denitrifying ones can. Plants like the Venus fly trap or the Sundews

supplement their diet with insects. They digest them with enzymes, and get extra nitrogen from the protein in the insect's bodies.

2. There are two known examples of nitrifying bacteria

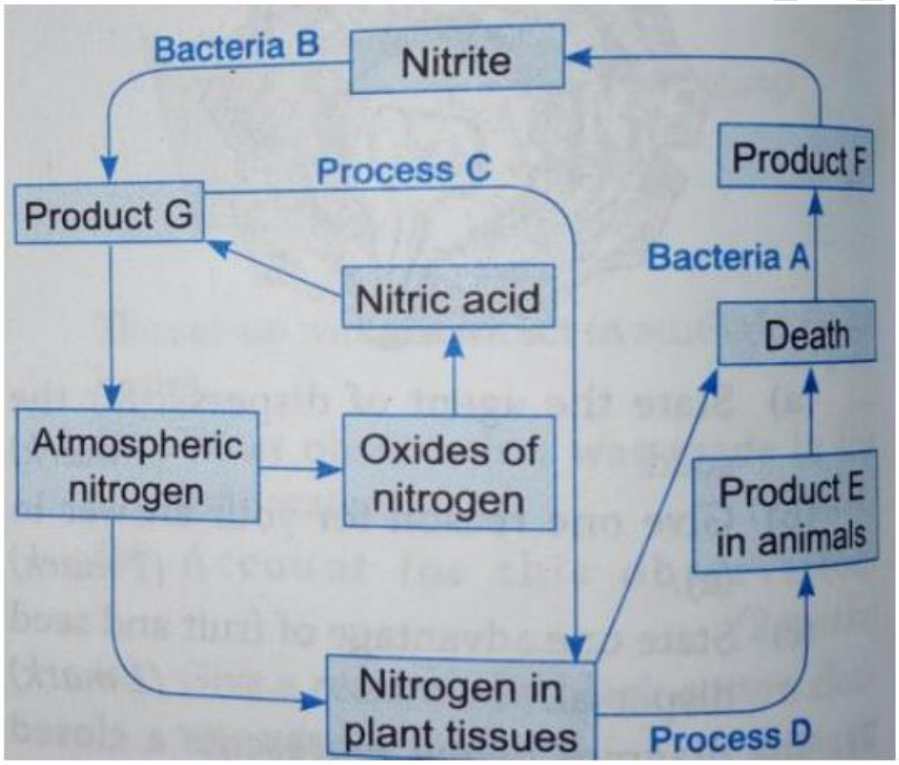
   a. *Nitrosomonas spp* which convert ammonium salts to nitrate

$$2O_2 + NH_4^+ \longrightarrow NO_2^- + 2H_2O + \text{Energy}$$

   b. *Nitrobacter* spp which convert nitrites to nitrates

$$O_2 + 2NO_2^- \longrightarrow 2NO_3^- + \text{Energy}$$

1.The figure below shows a diagram of the nitrogen cycle.



(a). Identify bacteria **A** and **B**
(b) Name processes **C** and **D**
(c.) Name products **E** and **F**
(d) State **two** ways in which free nitrogen in the air is made available for plant use.
2.(a)State how flowering plants obtain nitrogen from the soil
(b)How is nitrogen utilized by plants?
(c.) Outline the possible sources from which plants obtain nitrates.
(d) Explain why water logged soils are usually deficient in nitrates