COMMENTARY

Cycles in Nature – Part 1

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LAST week I introduced three of the six most important nutrient cycles in our environment. Without these cycles substances like oxygen, hydrogen, carbon, phosphorous and sulphur would not be found.

They are very important as they are needed by plants or animals or both in order to survive or to manufacture substances needed for survival. In this article I will deal with the Phosphorous, Sulphur and Nitrogen cycles and how humans have influenced them.

Phosphorous enters the cycle when it is released from rocks as they undergo the process of weathering and break down into smaller pieces. Phosphate is leached from these pieces by the rain and absorbed by the soil, in the organic matter or in the soil itself, if it is a clayey soil. It is now ready to be taken up by plants and passed along the food web by consumption. Herbivores eat these plants and then they themselves are consumed by carnivores. Phosphorous exits the bodies of these animals in the urine, faeces and when the organism dies and decays.

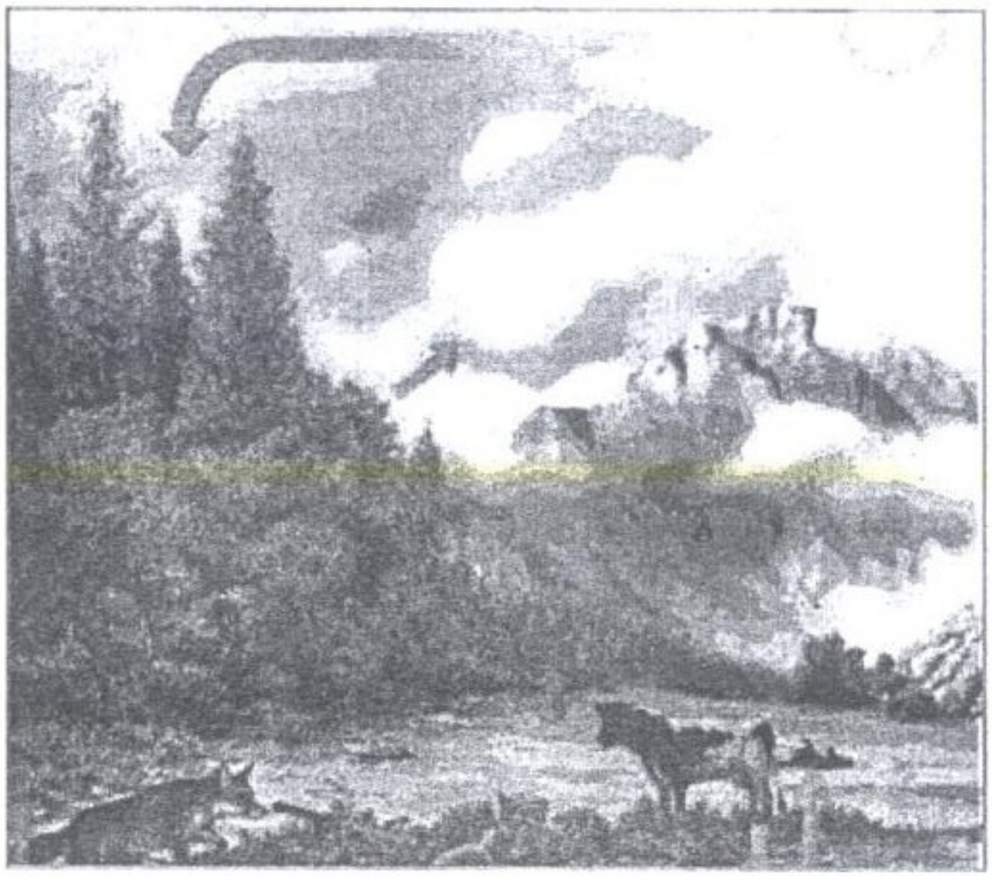
Plants require phosphorous as a nutrient necessary for growth. Phosphorous is also needed by both plants and animals in order to synthesize substances like adenosine triphosphate (ATP) which is important for the storage and use of energy, nucleic acids which form part of our DNA and phospholipids which act as channels to let substances pass between the membranes of cells.

Like the other nutrient cycles, that were explained last week, there is also an aquatic component to the cycle of this nutrient. In water it combines with iron to form iron phosphate, which is insoluble and is stored in this form. However, it can re-enter the cycle if it forms in shallow water, the wave action will erode the rock. However, in deeper waters, it is only released if there is a general uplifting of the rock formation itself.

As with the other nutrient cycles, humans can influence the phosphorous cycles mainly by introducing synthetic phosphates as plant fertilisers and from releasing sewerage that has not been properly treated. The plants cannot utilize all of this phosphorous, resulting in the excess entering our rivers and streams via surface run-off and is stored in the sediment.

Sulphur has a cycle similar to that of phosphorous. It is released via the weathering of rocks. Instead of combining with water, it combines with the air to form a sulphate. Of course, weathering of rocks is not the only process by which sulphur enters the atmosphere.

Other source producing methods include volcanic eruptions, forest fires, the evaporation of water, and breakdown of organic matter in swamps and tidal flats. In this form sulphur is taken up by plants, and passed along the food web via consumption; first by herbivores, and then carnivores which consume the herbivores and release sulphur back into the environment when they die and decay.



Sulphur does combine with water and enters our freshwater sources and oceans. There it combines with iron forming a compound known as ferrous sulphide, which gives most marine sediments its characteristic black colour. This substance is crucial for plants as it is needed during photosynthesis to convert carbon dioxide into sugars as a form of energy storage. It is also needed to manufacture defence chemicals that protect again herbivory. So without it, besides not having plants to continue our food web, sulphur plays a very important role in our lives and is needed to manufacture many proteins and vitamins.

Humans again impact this cycle by adding extra sulphur into the atmosphere by the burning of fossil fuels, which combine with water to produce acid rain. This in turn increases acidification of water beyond the tolerance level of many organisms which might lead to their extinction in extreme cases.

The Nitrogen cycle starts off with nitrogen in the atmosphere. Here it combines with oxygen to form two compounds; nitric oxide and nitrogen dioxide. However, these are only produced under certain conditions such as high temperatures, and pressure created near lightening bolts. This is the combustion reaction needed to run power plants or internal combustion engines. The latter compound, nitrogen dioxide, may react with water in the atmosphere and fall to Earth's surface as a dilute acid rain.

The effects of this acid are not as severe as the acid rain caused by excess sulphur, as it is in a form now usable by plants.

It should also be noted that animal waste, as it decomposes, produces nitrates. Some plants are able to turn nitrogen in the atmosphere into nitrates through nitrogen fixing bacteria contained in nodules in their roots; legumes have the ability to do this. Therefore nitrogen is important as a fertiliser for growth in plants. They also form part of amino acids needed to make proteins. The nitrogen is returned to the atmosphere through a process called denitrification, where nitrates are turned into nitrogen gas. A by-product of this reaction is nitrous oxide, a greenhouse gas that contributes to global warming.

The presence of these three nutrients is vital to the growth and development of both plants and animals. However, when the amount of these substances in the atmosphere increases because of human activities, it has severe consequences for all organisms that call this planet home.

For instance, too much nitrous oxide contributes to global warming, and too much sulphur leads to the formation of acid rain and increased acidification in oceans. Therefore I hope that after reading this article, we can see the sensitivity of these cycles, and how altering them can lead to detrimental effects on the environment.