**Nitrogen Cycle: Explanation**

Biogeochemical Cycles

Biogeochemical cycles are complex processes in which inorganic molecules are cycled through an ecosystem. The cycle involves geologic as well as biological processes. Many of the common molecules important to life go through this process, including water, nitrogen, phosphorous, calcium, potassium, magnesium and sulfur.

The nitrogen cycle has a complex pathway that involves many different species of organisms. Nitrogen is the most abundant gas in Earth’s atmosphere, accounting for 77% of the air we breathe. Though there is plenty of nitrogen present in the atmosphere it is usually the limiting nutrient in plant growth. In its gaseous state, nitrogen (N2) is very stable and is not usable by most living organisms.

Fixation

Nitrogen gas must go through a process called fixation by which nitrogen is converted to ammonium or nitrate before it can be used by most living organisms. There are two main processes by which nitrogen fixation occurs. The first is called high-energy fixation. This happens when large amounts of energy pass through the atmosphere, causing N2 to bind with hydrogen ions in the water. Sources of high energy are solar radiation, meteorites and lightening strikes. High-energy fixation accounts for a small percentage of nitrogen fixation. The primary sources of fixation come from specialized bacteria. Rhizobium forms a symbiotic relationship with the roots of legume plants to provide the plants with a form of nitrogen that they can use. Other organisms that can perform nitrogen fixation include cyanobacteria and free-living aerobic bacteria.

Nitrification

Several species of bacteria can use ammonia as an energy source, through the process called nitrification. Nitrosomas bacteria oxidize ammonia to produce energy, creating nitrite in the process. Nitrite is toxic to most plants, but is rarely a problem. Closely associated with nitrosomas is another bacterium, called nitrobacter. Nitrobacter utilizes the nitrite as a food sources and release nitrate as a waste product. Not of these bacteria types are aerobic, meaning they utilize oxygen to metabolize the ammonia and nitrite ions.

Nitrite production: NH4++ 2O2 🡪 NO2- + 2H2O

Nitrate production: NO2- + O2 🡪 2NO3-

Assimilation

Once nitrogen is in the form of NH4+ or NO3- it can be taken up readily by plants through their roots. Although plants can utilize ammonium, they take up nitrates more easily, assimilating the nitrogen in amino acids. Assimilation is an energy consuming process that allows organisms to utilize nitrogen in the production of proteins. When animals eat plants, they acquire nitrogen in the form of amino acids.

Dentrification

Another process involving bacteria will take useable nitrate and convert it back into N2 gas. This process is called denitrification. Denitrifying bacteria are anaerobic, metabolizing nitrate without oxygen. As a result, the nitrogen is returned to the atmosphere until it goes through the fixation process again.

Nitrogen Lab Questions

1. What was missing in each of the tanks to prevent the nitrogen cycle from functioning? What was the result?
2. What would happen in each tank without the nitrogen cycle? Why?
3. Do fish create the nitrogen found in the ammonia they excrete? If not, where does the nitrogen come from?
4. What was added to the system? If this were a closed system, how would it differ?
5. What happens to pH levels as ammonia is converted to nitrate?
6. Besides ammonia, what else needs to be present for the nitrification process to work?

7) Humans have altered the influx of nitrogen at different stages of the nitrogen cycle. Pick one way in which this happened and explain what the long-term effect may be on the environment.