**2.2 Nutrient Cycles in Ecosystems – Nitrogen & Phosphorous**

**What About Nitrogen???**

* Nitrogen is very important in the structure of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + In animals, proteins are vital for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + In plants, nitrogen is important for\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The largest store of nitrogen is in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Approximately \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of Earth’s atmosphere is N2 gas.
  + Nitrogen is also stored in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and as organic matter in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Smaller nitrogen stores are found in terrestrial ecosystems and waterways.

**So How does Nitrogen Cycle?**

* Nitrogen is cycled through processes involving plants.
  1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**1. Nitrogen fixation** is the conversion of \_\_\_\_\_\_\_\_\_\_\_\_ into compounds containing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* + Nitrates and ammonium are usable by plants.

Three ways of fixing nitrogen:

* + 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_\_ provides the energy for N2 gas to react with O2
       - Compounds formed by these ions then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_via precipitation.
       - This provides only a small amount of nitrogen fixation.

1. ­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ like Rhizobium convert N2 gas into ammonium.
   * + - The plants provide sugars, while bacteria provide nitrogen ions. (symbiotic relationship)
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_convert N2 into ammonium during the process of photosynthesis.

**2. Nitrification** occurs when certain soil bacteria \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

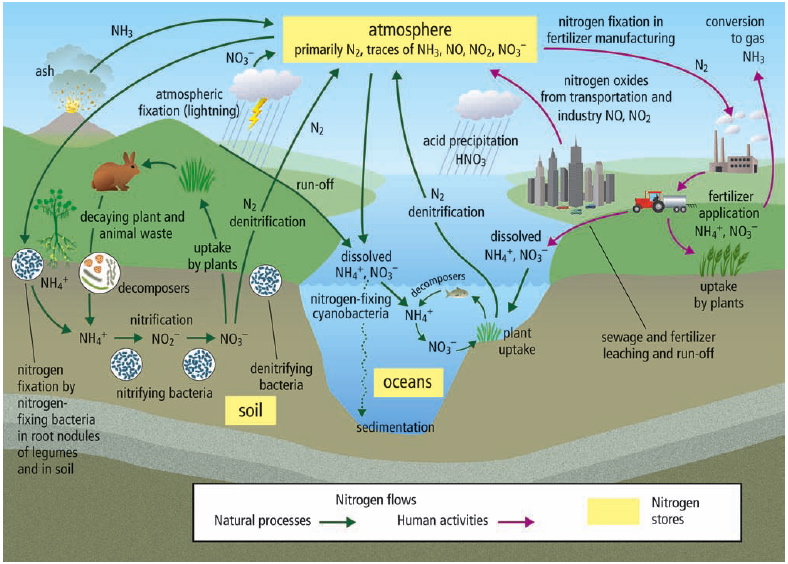
* + Ammonium is converted first to nitrite (NO2–), and then to nitrate (NO3-).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ enter plant roots through the process of:

**3.**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* + These nitrogen compounds compose plant proteins.
  + Herbivores then eat plants for DNA and protein synthesis.
* Nitrogen is returned to the atmosphere via \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are converted back to\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + N2 is also returned to the atmosphere through volcanic eruptions.

**The Whole Nitrogen Cycle:**



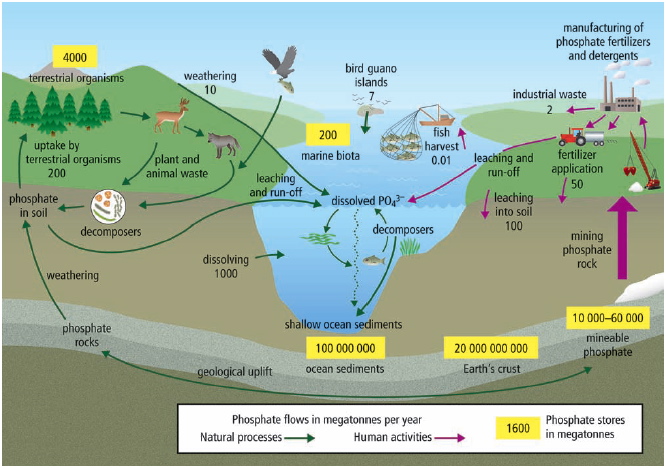
* Excess nitrogen dissolves in water, enters the waterways, and washes into lakes and oceans.
* The nitrogen compounds eventually become trapped in sedimentary rocks and will not be released again until the rocks undergo hundreds of years of weathering.

**Human activities can also affect the nitrogen cycle.**

* Due to human activities, the amount of nitrogen in the ecosystem has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and treating sewage releases nitrogen oxide (NO) and nitrogen dioxide (NO2).
    - Burning also releases nitrogen compounds   
      that increase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the form of nitric acid (HNO3).
  + Agricultural practices often use large amounts of nitrogen containing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Excess nitrogen is washed away, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, into the waterways.
    - This promotes huge growth in aquatic algae called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Algae blooms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, killing many aquatic organisms.
    - Algae blooms can also produce neurotoxins that poison animals.

**The Phosphorous Cycle**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is essential for life processes in plants and animals.
  + a part of the molecule that carries energy in cells.
  + promotes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, stem strength, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + phosphorous and calcium are important for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Phosphorous is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the atmosphere.
  + trapped in phosphates (PO43–, HPO42–, H2PO4–) found in rocks and in the sediments on the ocean floor.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ releases these phosphates from rocks.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, via acid precipitation or lichens
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, including wind, water and freezing
  + *Weathering does not occur until there is geologic uplift, exposing the rock to chemical and physical weathering.*
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which are then eaten by animals.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the environment through mining for fertilizer components.
  + Extra phosphorous, often along with potassium, then enters the ecosystems faster than methods can replenish the natural stores.
* Humans can also reduce phosphorus supplies.
  + Slash-and-burning of forests removes phosphorous from trees, and it then is deposited as ash in waterways.



**How Changes in Nutrient Cycles Affect Biodiversity**

* Any significant changes to any of these nutrients (C, H, O, N, or P) can greatly affect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Carbon cycle changes contribute to climate change and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + ­­­­­­­­­­­­­­­­­­­­Increased levels of nitrogen can allow certain plant species to grow too fast, which kills other plants and decreases resources for every species in the food web.
  + Decreased levels of phosphorous can inhibit the growth of algae that are very important producers in many food chains.

**Review**

**Carbon Cycle**

**Photosynthesis:**

Reactants Products

6CO2 + 6H2O + Energy 🡪 C6H12O6 + 6O2

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Cellular Respiration**:

Reactants Products

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Glucose (sugar) + oxygen gas 🡪 carbon dioxide gas + water + energy

**Nitrogen Cycle**

1) Nitrogen Fixation: **N2 🡪 NH3**

2) Dissolves in water: **NH3 🡪 NH4+**

3) Nitrification: **NH4+ 🡪 NO2- 🡪 NO3-**

4) Dentrification: **NO3- 🡪 N2**

**Phosphorous Cycle**

* + 1. Weathering \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and releases phosphate into the soil.
    2. Organisms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ phosphorous.
    3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_phosphorous to the soil after plants and animals die.
    4. Phosphorous becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.