Nitrogen Cycle

Honors Biology
Arizona College Preparatory
Nitrogen Cycle Facts

• Nitrogen is an element and a member of the nitrogen family on the periodic table.
• Nitrogen is found in all living organisms. It is essential to nucleic acids and proteins.
• Nitrogen is an important part of non-living things like the atmosphere and soil.
• Atoms of nitrogen don't just stay in one place. They move slowly between living things, dead things, the air, soil and water as they convert from one substance to another.
Major Reservoirs

- **Atmosphere**: Approximately 80% of the molecules in Earth's atmosphere are made of two nitrogen atoms bonded together (N₂).
- **Land Biomass**: All plants and animals need nitrogen to make amino acids, proteins and DNA.
- **Genetic Material**: Nitrogen (N) is an essential component of DNA, RNA, and proteins, the building blocks of life.
- **Soil**: Many conversions of nitrogen happen through bacteria found in soil.
Major Processes

• Nitrogen Fixation
• Nitrification
• Denitrification
• Assimilation
• Decay
• Ammonification
Nitrogen Fixation

Plants and animals cannot take nitrogen directly out of the atmosphere so it must be “fixed.”

**By nitrogen-fixing bacteria:** Most of these bacteria live in symbiosis with legumes, a simple nut-like dried fruit within the soil. Examples include peanuts and potatoes. This accounts for 90% of the atmospheric nitrogen that is fixed.

**By lightning, forest fires and hot lava flows:** These events fixate small amounts of nitrogen. The energy is enough to break the triple covalent bonds that hold two nitrogen atoms together and free up nitrogen for other chemical processes. This accounts for the remaining 10% of nitrogen fixation.
Nitrification & Denitrification

Nitrification

The process by which ammonia (NH$_3$) becomes nitrates (NO$_3$) by nitrifying bacteria. Nitrates can be taken up through assimilation and are able to be used by most living organisms that obtain nutrients from the soil.

Denitrification

The loss or removal of nitrogen or nitrogen compounds; specifically: reduction of nitrates or nitrites commonly by bacteria (as in soil) that usually results in the escape of nitrogen into the air. This is when nitrogen molecules that can potentially be taken up through assimilation instead take a path that converts them back to the unusable form of atmospheric nitrogen.
Assimilation

Nitrates are quickly incorporated into protein and other organic nitrogen compounds, either by a host plant, the bacteria itself, or another soil organism. Assimilation is the process by which nitrates become part of these living organisms.
Decay & Ammonification

Decay

When organisms die, their cell structure decomposes bringing the nitrogen into soil on land or into ocean water. Bacteria (decomposers) help with breaking down the cell structure and organic components of the organisms.

Ammonification

Ammonification is the process by which dead organic matter is converted into Ammonia (NH$_3$).
Human Impact

Certain actions of humans are causing changes to the nitrogen cycle and the amount of nitrogen that is stored in the land, water, air, and organisms.

1. The use of nitrogen-rich fertilizers can add too much nitrogen in nearby waterways as the fertilizer washes into streams and ponds. This promotes growth of plants and can change the dynamic stability of an ecosystem.

2. Waste associated with livestock farming also adds large amounts of nitrogen into soil and water. The increased nitrate levels cause plants to grow rapidly until they use up the supply and die.
What to Do & What to Know

**What to Do:**
1. Go through the worksheet provided and fill in the blanks for the information below. It will be checked during class.

**What to Know:**
- You must be familiar with the reservoirs and processes of the nitrogen cycle.
- You should be comfortable describing each process using your own words.
- You must know that nitrogen is present in amino acids, proteins, and nucleic acids.
- You must be familiar with the molecular formulas of the different types of forms of nitrogen: atmospheric nitrogen, ammonia, & nitrates.
- You should practice diagramming out the nitrogen cycle and describing what happens in each process.