Recycling Matter

Big Picture

Biogeochemical cycles describe how organisms can continuously survive over millions of years. The recycling of water, carbon, and nitrogen are the most important cycles in the biosphere. Water, carbon, and nitrogen undergo changes to form different physical and chemical state in a continuous process. They pass through food webs and are combined and recombined in different ways. Each of their steps within the cycles affects both biotic and abiotic components.

Key Terms

Biogeochemical Cycles: The passing and recycling of different chemical elements through biotic and abiotic components of the biosphere.

Exchange Pool: Part of a biogeochemical cycle that holds water or another element for a short period of time.

Reservoir: Part of a biogeochemical cycle that holds water or another element for a long period of time.

Water Cycle: The continuous movement of water in our biosphere.

Evaporation: The process where water in its liquid form changes into its gas form.

Sublimation: Water in its solid state directly forms water vapor.

Transpiration: Occurs when plants release water through leaf pores called stomata.

Condensation: The process in which water vapor changes into tiny droplets of water.

Precipitation: A stage that may occur after condensation. If the tiny droplets get large enough, they will fall.

Groundwater: Precipitation that is absorbed into the ground.

Carbon Cycle: The continuous process in which carbon is exchanged throughout the biosphere.

Nitrogen Cycle: Process by which nitrogen moves through the biosphere.

Assimilation: When plants absorb and incorporate nitrogen into organic compounds.

Nitrogen Fixation: The process of combining nitrogen with hydrogen to form ammonia.

Nitrification: Production of nitrate from ammonia.

The Water Cycle

One important **biogeochemical cycle** is the **water cycle**. There is no beginning or end to the water cycle. The cycle takes place on, above, and below Earth's surface. We often think of water in its liquid form, but it can also exist as a gas (water vapor) or a solid (ice). The form of water changes as it goes through the water cycle.

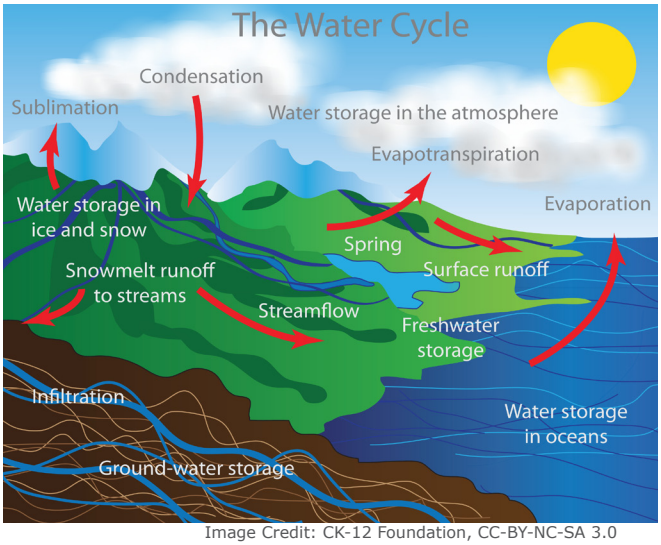
Liquid ⟶ Gas:

- **Evaporation** occurs when the sun heats liquid water molecules and transfers enough energy for them to escape into the atmosphere.
- **Sublimation** can occur if heat from the sun is able to change ice and snow directly to water vapor without melting it into liquid water first.
- Water is a product of photosynthesis. In **transpiration**, that water can be released from plants as vapor through leaf pores called stomata.

Gas ⟶ Liquid:

- In **condensation**, water vapor *condenses* to form tiny droplets of water.
- If the droplets get large enough, they can fall as **precipitation**. Rain, snow, sleet, hail, and freezing rain are all types of precipitation.
- Once the precipitation falls on land, it can form runoffs that flow over the surface of the ground. Runoffs may possibly return to a body of water (like a lake, a river, or the ocean).
- If the precipitation gets absorbed into the ground, it becomes **groundwater**. Groundwater can seep out of the ground at a spring or ocean, be absorbed by plant roots, or flow into an aquifer deep underground.

Not all parts of the water cycle proceed at the same speed. A **reservoir** like the ocean is capable of holding liquid water for a long time. The atmosphere, however, is an **exchange pool** that can only hold water for a couple of days.



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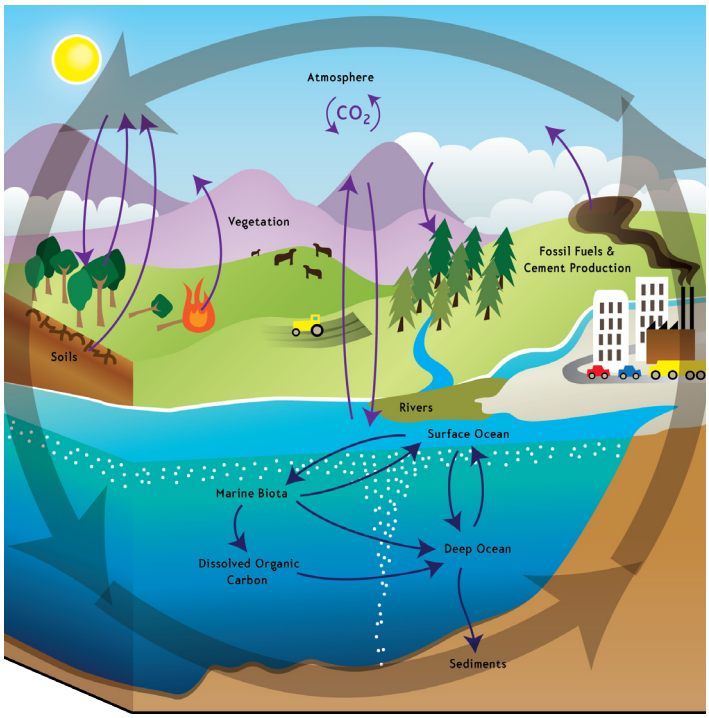
Recycling Matter cont.

The Carbon Cycle

The **carbon cycle** is another important biogeochemical cycle.

- We know that producers (autotrophs) undergoing photosynthesis need carbon. The producers get the carbon they need by removing carbon dioxide from the atmosphere.
- Carbon dioxide is also released during the process of cellular respiration, which is when organisms use oxygen and glucose to create their own energy.
- Carbon dioxide can also be released by burning wood and other carbon-containing materials (like fossil fuels).
- Runoff, rivers, and streams can also dissolve carbon in rocks and carry it to the ocean. This is a much slower process than photosynthesis and respiration.
- Limestone is an example of a carbon-containing rock. Carbon is in limestone because marine organisms use carbon dioxide to form calcium carbonate shells. Over millions of years, their leftover shells form sediments that become a part of limestone.



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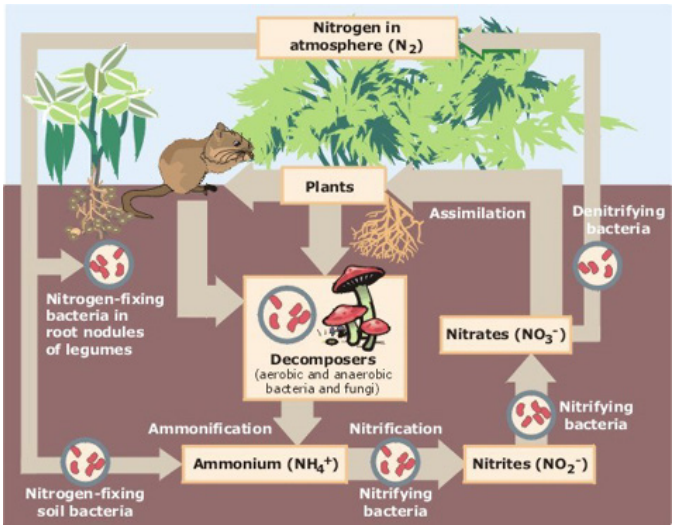
The Nitrogen Cycle

Although not as obvious as the water cycle and the carbon cycle, the **nitrogen cycle** is also an important biogeochemical cycle.

- Nitrogen is in proteins, nucleic acids, and chlorophyll.
- Plants need nitrogen to make important organic compounds. The process of incorporating nitrogen into organic compounds is called **assimilation**. Although nitrogen gas makes up 78% of air, plants cannot use nitrogen gas directly.
- **Nitrogen fixation** is the process that converts the nitrogen gas into nitrates that plants can absorb through their roots. Some nitrogen-fixing bacteria living in the soil and in roots carry out this process.
- Some bacteria during the process of decomposition are able to release nitrogen in the form of ammonia. During **nitrification**, the ammonia is changed into nitrates. This is another way plants can get nitrogen.
- Denitrifying bacteria change nitrates back into nitrogen gas, returning nitrogen into the atmosphere.



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