Carbon-Oxygen Cycle

Biogeochemical cycles *are predictable pathways followed by chemical elements or molecules as the elements or molecules travel through the living and nonliving parts of an ecosystem.*

Biogeochemical Cycles

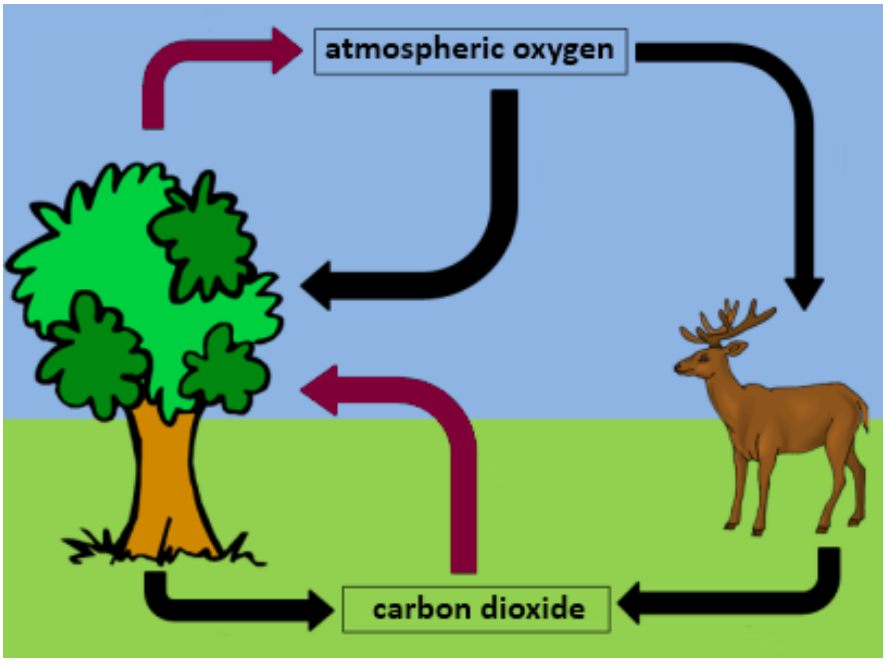
Matter is neither created nor destroyed. Instead, it is converted from one form to another. As it changes forms, it often moves among the Earth's biosphere, atmosphere, lithosphere, and hydrosphere.

Carbon and oxygen are two of the forms of matter that move in cyclic paths through the Earth's layers. These cyclic paths are called **biogeochemical cycles**.

Photosynthesis & Respiration in the Carbon-Oxygen Cycle

The carbon and oxygen cycles are sometimes discussed separately. However, these cycles can also be addressed together since they are interdependent, or reliant upon each other for proper operation. This combined, two-part, interdependent cycle is known as the carbon-oxygen cycle.

There are two primary natural processes that drive the carbon-oxygen cycle: photosynthesis and cellular respiration. Each of these processes must take place in order for the other half of the cycle to function properly because the products of one process are the reactants of the other.



The black arrows represent the flow of oxygen and carbon dioxide due to cellular respiration. The magenta arrows represent the flow of gases due to photosynthesis.

Photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

The products of photosynthesis are glucose and oxygen. These materials are the reactants of cellular respiration.

Cellular Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

The products of cellular respiration are carbon dioxide and water. These materials are the reactants of photosynthesis.

Other Processes in the Carbon-Oxygen Cycle

There are several processes that, in addition to photosynthesis and cellular respiration, either store carbon dioxide or release it into the environment. These processes are summarized in the table below.

Process	Natural or Man-made	CO_2 Released or Stored
photosynthesis	natural	stored
cellular respiration	natural	released
erosion	both	released
combustion of fossil fuels	man-made	released
burning of forests	both	released
sedimentation & compaction	natural	stored
decomposition	natural	released

The Nitrogen Cycle

*The **nitrogen cycle** is the cycle of consumption and regeneration of nitrogen within our environment.*

Overview

Nitrogen is an essential component of amino acids (proteins) and nucleic acids (DNA and RNA). Therefore, all organisms require nitrogen to survive. Even though nitrogen is the most abundant gas in the atmosphere, most organisms are unable to use this form of nitrogen. However, there are a few microscopic organisms and natural processes, such as lightening, that can convert unusable nitrogen in the atmosphere to usable forms of nitrogen.

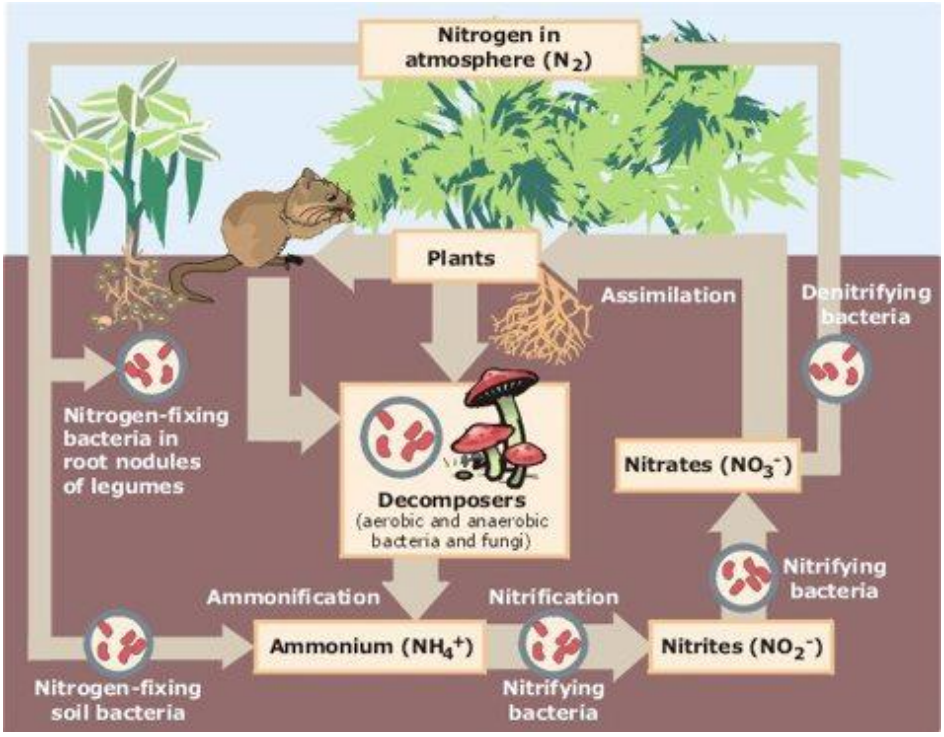


Image is courtesy of the EPA.

During the nitrogen cycle, atmospheric nitrogen (N_2) is **fixed** or changed into nitrogen containing compounds, such as *ammonia* or *nitrates*, by nitrogen-fixing bacteria. Plants can then absorb the nitrogen compounds from the soil and use it to form chlorophyll and other important biological molecules.

Consumers must obtain nitrogen from the organisms they consume. Herbivores receive their nitrogen from the plants that they eat, and carnivores get their nitrogen from the animals they consume. However, all organisms depend on the ability of nitrogen-fixing microbes to convert atmospheric nitrogen into a form of nitrogen that plants can *assimilate*, or take in and use.

Finally, nitrogen is returned to the atmosphere through the combustion of fossil fuels or when bacteria or fungi break down the nitrogen found in fertilizers, urine, and dead plants and animals.

Nitrogen Cycle Video

The following video describes the nitrogen cycle.

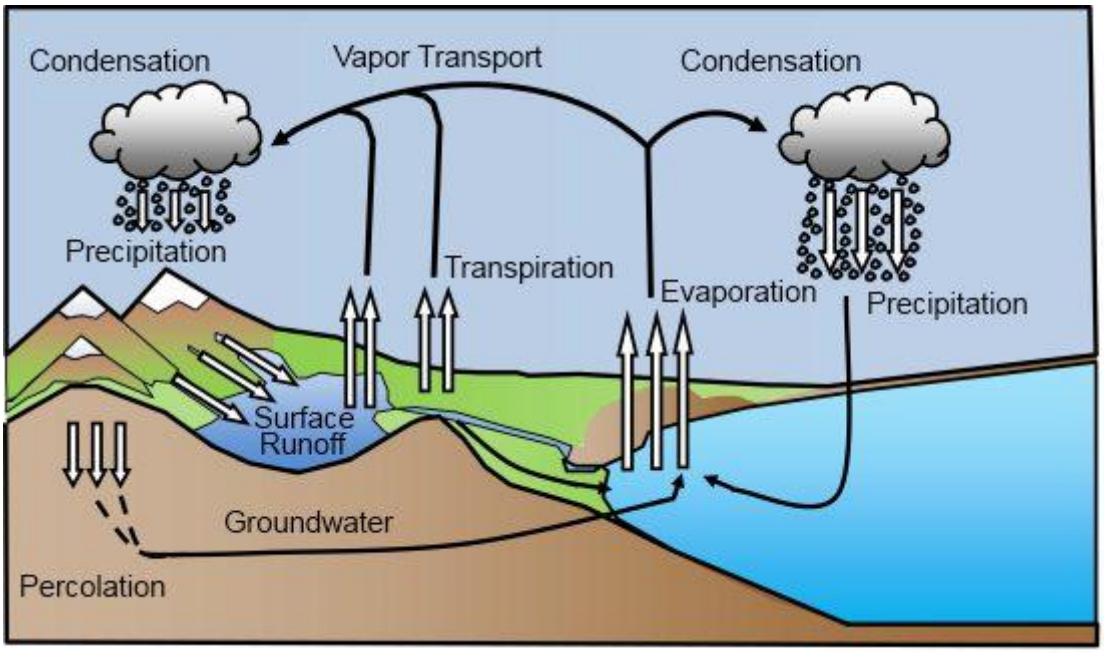
Clip provided by Education Clip Library with permission from ITN Source

Water Cycle

*Water is constantly being recycled through the **water cycle**, or the hydrologic cycle. The water cycle describes the continuous movement of water on, above, and below the surface of the Earth.*

The amount of water on Earth remains constant, but it continuously changes forms as energy from the Sun drives the cycle.

The water cycle describes how water moves from one stage of the cycle to the next. Actually, there is much more water being stored in the cycle than is moving through the cycle. Water may be stored for a short time as water vapor in the atmosphere, for days or weeks in a lake, or for thousands of years in a polar ice cap.



The water cycle is a cycle with no beginning or end. It includes the following processes:

Condensation is the changing of gas to a liquid (water vapor to water) and is crucial for the formation of clouds. Clouds form in the atmosphere when air containing water vapor rises and cools. Water vapor can be present in the air even when clouds are not visible. Clouds become visible when the water molecules combine with other water molecules and tiny particles and form cloud droplets.

Water returns to the Earth as precipitation. **Precipitation** is the process by which water molecules condense to form drops heavy enough to fall to the Earth's surface. During **infiltration**, also called **percolation**, water fills the porous spaces in the lithosphere. **Surface runoff** occurs when no more water can be absorbed into the ground, and gravity pulls it downhill. Water flows over land and forms rivers. Rivers usually flow into the ocean, and the water cycle continues from there.

Evaporation and transpiration are similar in that they are both processes in which water is changed into water vapor. **Evaporation** often happens as a result of heat – liquid water is heated until it turns to a gas, water vapor, and is released into the atmosphere. **Transpiration** is the process by which water is carried through plants, from roots to leaves, where it changes to water vapor and is released to the atmosphere.

Sublimation is the changing of water from a solid directly to a gas with no intermediate liquid stage. The opposite of sublimation is **deposition**, when water vapor changes directly to a solid – ice. Snowflakes and frost are examples of deposition.