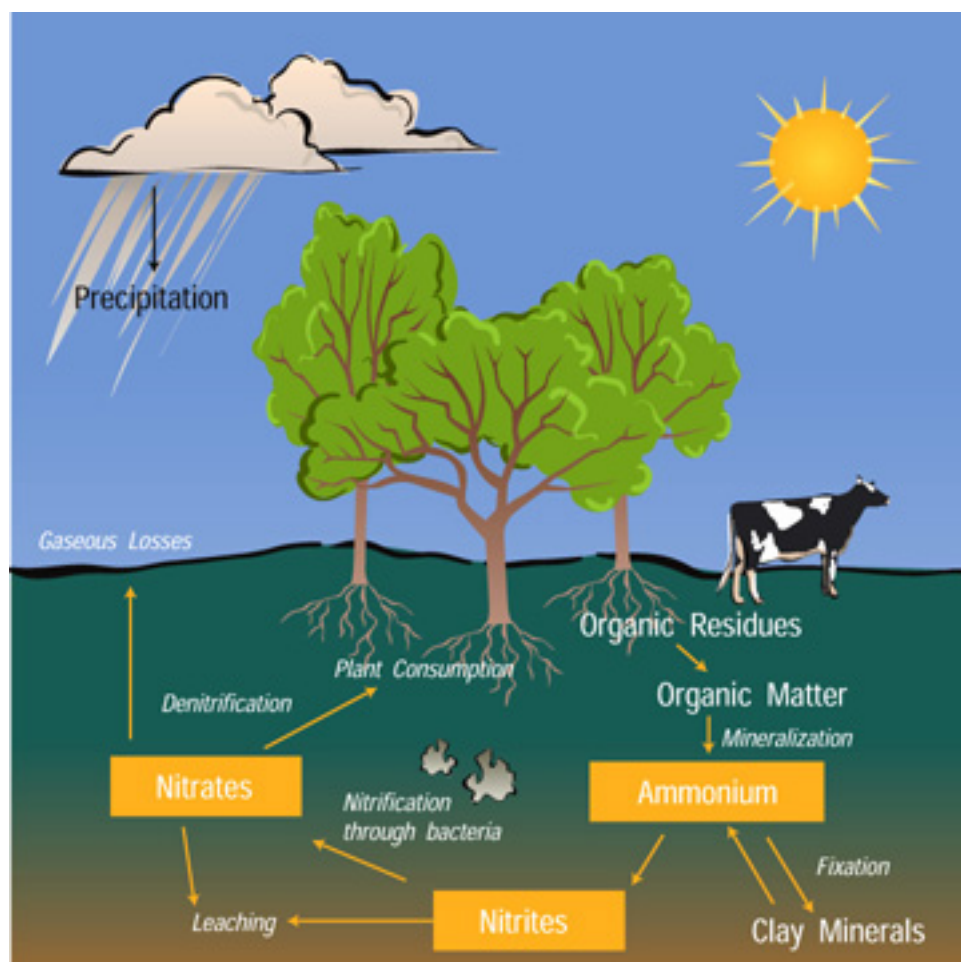


## My NASA Data - Interactive Models

### The Nitrogen Cycle Game



Most of the nitrogen on Earth is in the atmosphere. Approximately 80% of the molecules in Earth's atmosphere are made of two nitrogen atoms bonded together ( $N_2$ ). All plants and animals need nitrogen to make amino acids, proteins and DNA, but the nitrogen in the atmosphere is not in a form that they can use. Atmospheric nitrogen must undergo a process called nitrogen fixation to be usable by living things. This can happen when molecules are torn apart by lightning or fire, by nitrogen fixing bacteria, or by bacteria from legumes. Other plants get the nitrogen they need from the soils or water in which they live mostly in the form of inorganic nitrate ( $NO_3^-$ ). Nitrogen is a limiting factor for plant growth. Animals get the nitrogen they need by consuming plants or other animals that contain organic molecules composed partially of nitrogen. When organisms die, their bodies decompose bringing the nitrogen into soil on land or into the oceans. As dead plants and animals decompose, nitrogen is converted into inorganic forms such as ammonium salts ( $NH_4^+$ ) by a process called mineralization. The ammonium salts are absorbed onto clay in the soil and then chemically altered by bacteria into nitrite ( $NO_2^-$ ) and then nitrate ( $NO_3^-$ ). Nitrate is the form commonly used by plants. It is easily dissolved in water and leached from the soil system. Dissolved nitrate can be returned to the atmosphere by certain bacteria in a process called denitrification.

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Certain actions of humans are causing changes to the nitrogen cycle and the amount of nitrogen that is stored in reservoirs. The use of nitrogen-rich fertilizers can cause nutrient leading in nearby waterways as nitrates from the fertilizer wash into streams and ponds. The increased nitrate levels cause plants to grow rapidly until they use up the nitrate supply and die. When the plant supply increases, so do the number of herbivores. However, when the plant supply dies off, there is increased resource competition in the herbivore population. In this way, changes in nutrient supply will affect the entire food chain. Additionally, humans are altering the nitrogen cycle by burning fossil fuels and forests, releasing various solid forms of nitrogen. Farming also affects the nitrogen cycle. The waste associated with livestock farming releases a large amount of nitrogen into soil and water. In the same way, sewage waste adds nitrogen to soils and water.

Sources:

1. *The Nitrogen Cycle Game* | Center for Science Education. (n.d.). UCAR Center for Science Education. Retrieved April 14, 2023, from <https://scied.ucar.edu/activity/nitrogen-cycle-game>
2. Krebs, E., Delac, J., & Smat, R. (2016, May 10). *The Nitrogen Cycle*. YouTube. Retrieved April 14, 2023, from <https://www.youtube.com/watch?v=PfqvACMyg68>

Teachers who are interested in receiving the answer key, please complete the [Teacher Key Request and Verification Form](#). We verify that requestors are teachers prior to sending access to the answer keys as we've had many students try to pass as teachers to gain access.

## Grade Band

- 3-5
- 6-8

## Supported NGSS Performance Expectations

- [5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.](#)
- [MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.](#)
- [HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.](#)

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## Related Resources

- [The Nitrogen Cycle Game](#)