Nutrient Cycles

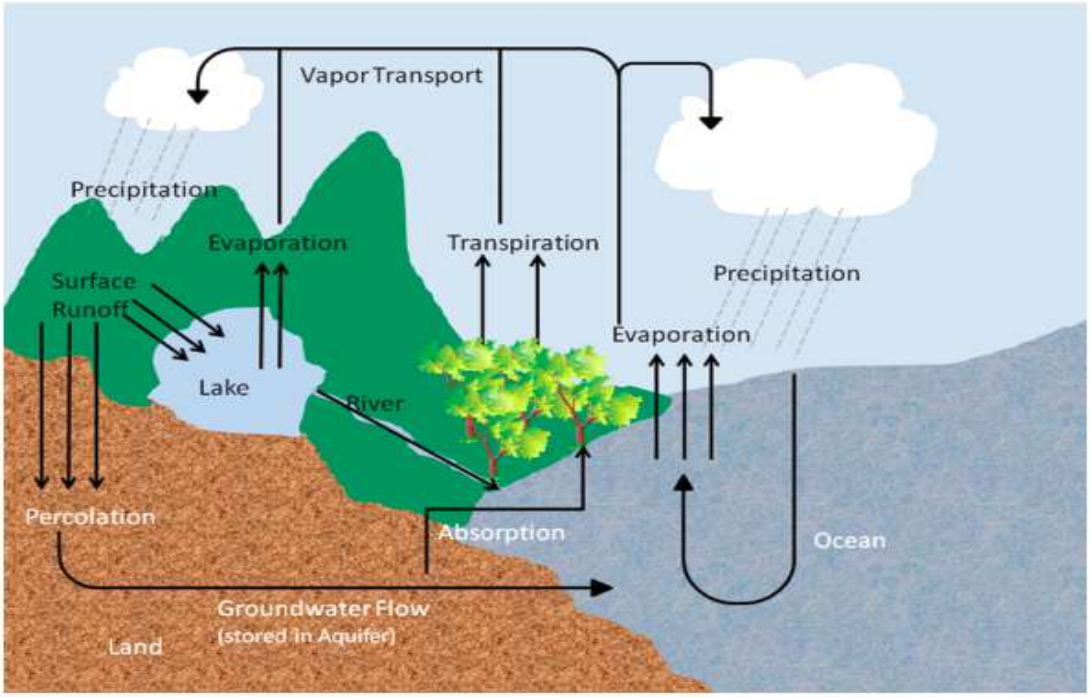
How are nutrients recycled through ecosystems?

Why? We have learned the importance of recycling our trash in middle school and at home. It allows us to use something again for another purpose and prevents the loss of natural resources.

- But what happens to the waste in nature?
- Why aren't we up to our necks in natural refuse?
- Why is there always a supply of water?
- Why is there oxygen to breathe and carbon dioxide for photosynthesis?

Organic compounds in nature are also recycled. This recycling process converts the complex organic compounds to simple, inorganic compounds, which then can be returned to nature to be used again and again.

Model 1 – The Water Cycle



1. Model 1 illustrates how nature recycles what natural resource?

2. Model 1 illustrates four major areas of water storage on Earth. Complete the list of these storage areas below.

   Atmosphere, surface water, _____, and _____.

3. Where is groundwater stored?

4. Name two processes in Model 1 in which water is converted to vapor.
   a. _____
   b. _____

5. Describe two methods by which water on land (in lakes and rivers) returns to the oceans.

6. Rain, sleet, and snow are examples of what?

7. If the air contains high levels of pollutants, what effect might this have on water quality?

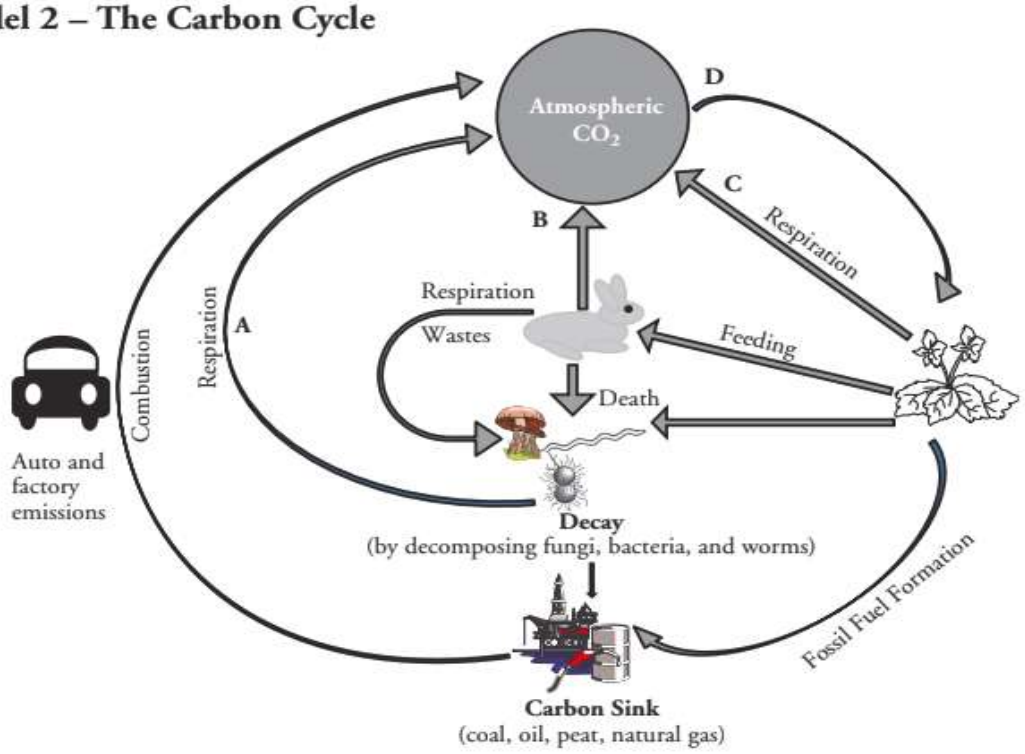
8. Which process(es) of the water cycle—precipitation, evaporation, condensation, runoff, percolation or transpiration—might contribute to the addition of pollutants to rivers, lakes, and oceans? Why?

9. Which of the processes associated with the water cycle might be responsible for helping to clean or filter the water?

10. The water cycle is a **closed system**, meaning no water enters from beyond the system nor leaves the system. What does that say about the importance of keeping the water on Earth free from pollution?

Part 2

Model 2 – The Carbon Cycle



1. Model 2 illustrates how nature recycles what natural resource?

2. Name two ways that carbon (usually in the form of CO_2) enters the atmosphere.

3. Process D on the diagram uses CO_2 from the atmosphere.
    a. Where on the diagram in Model 2 with the name of this process.

    b. What organisms carry out the process identified in part *a*?

4. Wastes and dead organisms must be broken down in order for their components to be used again.
    a. What organisms in the cycle carry out this process?

    b. What would happen if decomposition did not occur?

5. Not all dead organisms are acted on by decomposers. Instead of being immediately recycled, the carbon from some organisms is kept in a type of long-term storage, or **carbon sink**. Using Model 2, answer the questions below about this long-term storage.
    a. List four materials that contain this stored carbon.

    b. What is the collective term for these four materials?

    c. How do humans use the materials in the carbon sink?

    d. What is the scientific name for the process listed in part *c*?

6. List five examples of combustion in your everyday life.

7. How is the majority of electricity generated in the area where you live? Does the process involve the combustion of coal?

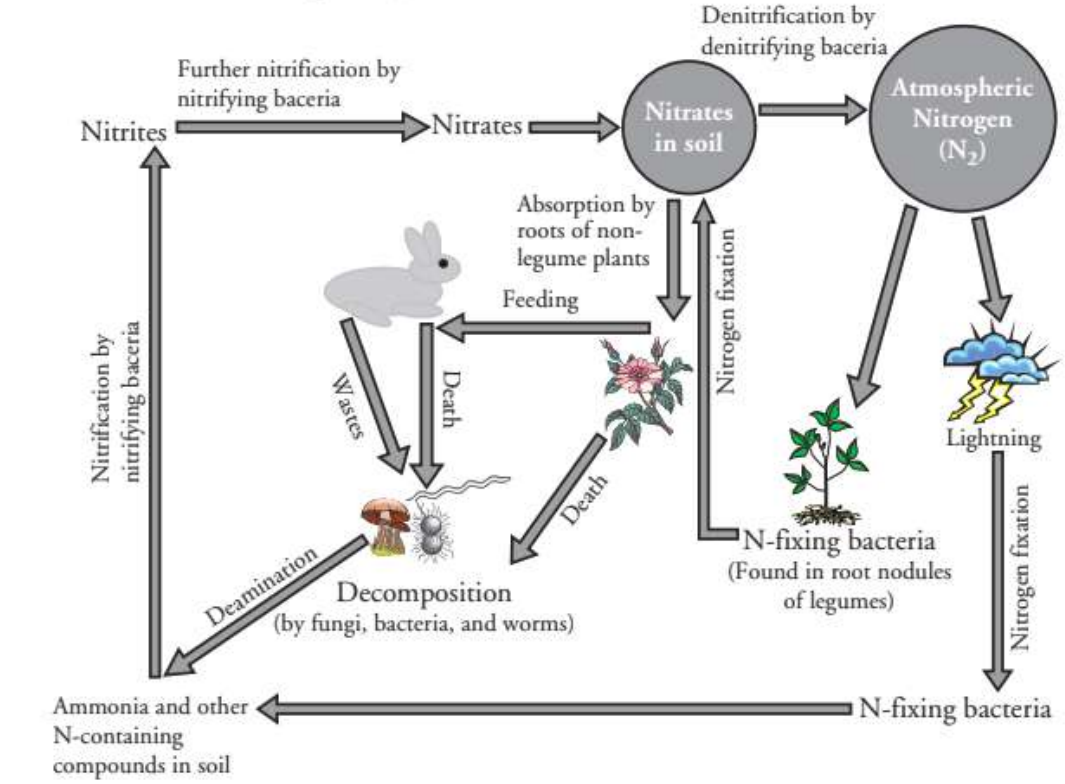
8. Many of the carbon-based fuels are categorized as fossil fuels because they formed from decayed organisms over millions of years. List as many examples of fossil fuels as you can.

9. How does our use of these carbon stores affect the amount of CO_2 in the atmosphere?

Read This! Carbon dioxide (CO_2) is one of the so-called **greenhouse gases**. These gases hold heat energy in the atmosphere, which raises the overall temperature of the Earth. This helps maintain the Earth's biosphere, but also has led to environmental concerns. The more CO_2 in the atmosphere, the higher the Earth's average temperature will be.

1. What is another way in which human activity is increasing the amount of atmospheric CO_2, and what are potential global effects of these changes in CO_2 levels?

Model 3 – The Nitrogen Cycle



2. Model 3 illustrates how nature recycles what natural resource?

3. Name three types of bacteria involved in the nitrogen cycle.

Read This!

Nitrification is a process by which specific bacteria convert different forms of N-containing compounds (like only forms ammonia, of nitrogen NH_3) in that the are soil usable to nitrites by plants (NO_2) and build nitrates in their proteins (NO_3). This process is important since the only forms of nitrogen that are usable by plants to build their proteins are the nitrates.
In what ways is N_2 gas removed from the atmosphere? By what process are animal wastes and dead organisms converted to other nitrogen-containing compounds?

1. What is the only form of nitrogen that non-legume plants can take in and use?

2. What do the denitrifying bacteria do during the denitrifying process?

3. If the number of nitrifying bacteria decreased, what effect would this have on the nitrogen cycle and what type of compounds would accumulate as a result?

Follow-Up Questions

Plants and animals are part of all of the nutrient cycles through the foods they eat and what eat them (food chains and food webs). Name the four classes of organic compounds (containing carbon) and explain how the carbon cycle and nitrogen cycle contribute to the usable supplies of these macromolecules.

In order to continually use the same area of land for agriculture, some farmers apply fertilizers to improve the level of nitrates in the soil. An alternative to this intensive use of fertilizer is to plow the roots of the leguminous plants back into the soil and leave the area unplanted for a season. Why would a farmer use this alternative method and what would be the benefit of turning over the soil and leaving the old plant roots?