Nutrient Cycles
How are nutrients recycled through ecosystems?

Why?

We have learned the importance of recycling our trash. 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. Name two processes in Model 1 in which water is converted to vapor.

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

3. 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?
4. 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?

5. **Model 2 – The Carbon Cycle**

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

6. Name two ways that carbon (usually in the form of CO$_2$) enters the atmosphere.

7. Process D on the diagram uses CO$_2$ from the atmosphere.
   - Label D on the diagram in Model 2 with the name of this process.
   - What organisms carry out the process identified in part a?
8. 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?

9. 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.
   o List four materials that contain this stored carbon.
   o What is the collective term for these four materials?
   o How do humans use the materials in the carbon sink?

10. How does our use of these carbon stores affect the amount of CO₂ in the atmosphere?

Read This!

Carbon dioxide (CO₂) 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 CO₂ in the atmosphere, the higher the Earth’s average temperature will be.

11. What is another way in which human activity is increasing the amount of atmospheric CO₂, and what are
    potential global effects of these changes in CO₂ levels?
12. Model 3 illustrates how nature recycles what natural resource?

13. 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 ammonia, NH₃) in the soil to nitrates (NO₃⁻) and nitrates (NO₃⁻). This process is important since the only forms of nitrogen that are usable by plants to build their proteins are the nitrates.

14. In what ways is N₂ gas removed from the atmosphere?

15. By what process are animal wastes and dead organisms converted to other nitrogen-containing compounds?
16. What is the only form of nitrogen that plants can take in and use?

17. 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?

**Extension Question**

18. Plants and animals are part of all the nutrient cycles through the foods they eat and what eats 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.