

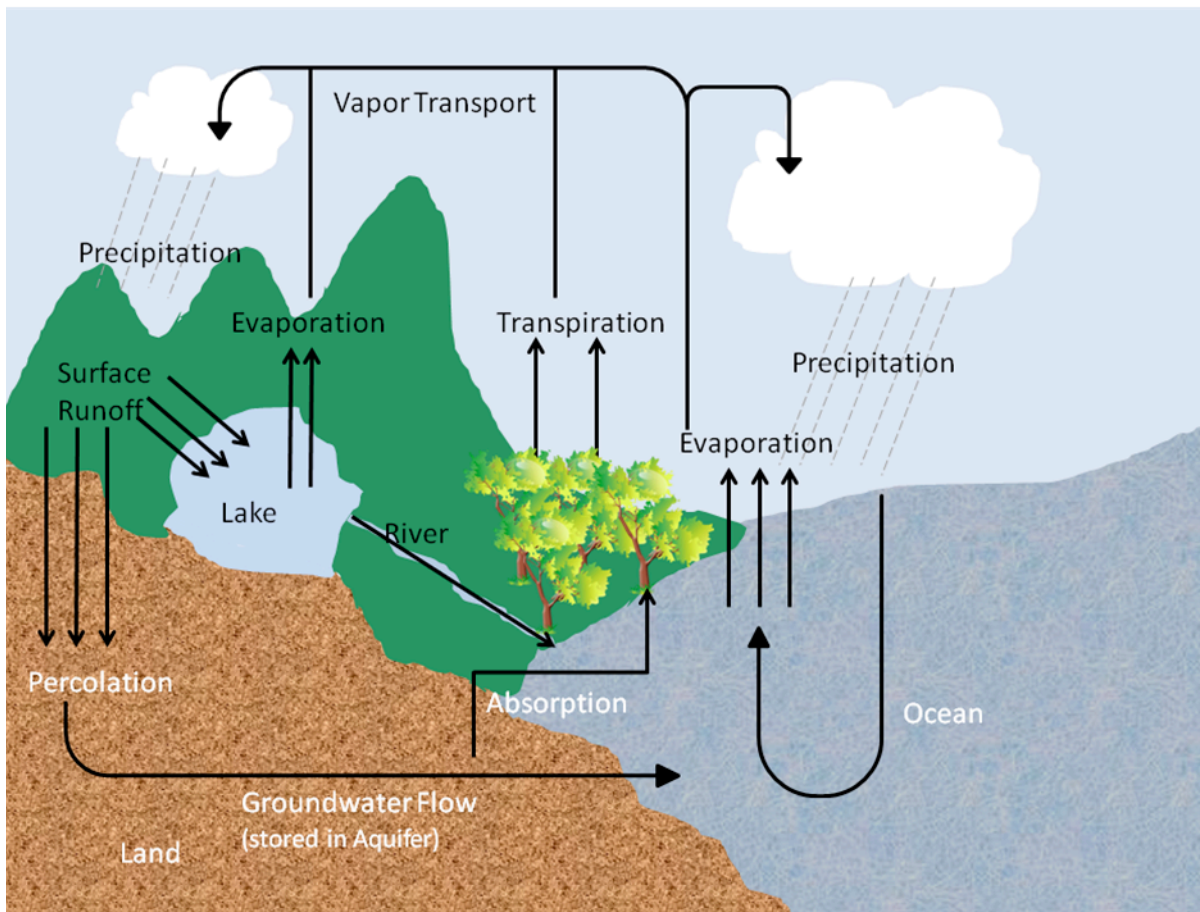
Nutrient Cycles

How are nutrients recycled through ecosystems? **through the biogeochemical cycles**

Why? **because atoms are recycled, not gained nor lost**

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. Model 1 illustrates how nature recycles what natural resource? **water**
2. Model 1 illustrates four major areas of water storage on Earth. Complete the list of these storage areas below.
Atmosphere, surface water, **groundwater**, and **living things**.
3. Where is groundwater stored? **in aquifers (underground water reservoirs)**

4. Name two processes in Model 1 in which water is converted to vapor. **evaporation, transpiration**

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

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

7. If the air contains high levels of pollutants, what effect might this have on water quality?
It will lower the water quality, making it useless to living things.

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? **They concentrate chemicals long their path**

Precipitation - acid rain

evaporation - concentrates pollutants left behind

runoff - water that comes down the mountain will carry debris and pollutants to aquifers, rivers, oceans

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

percolation: water gets filtered by soil

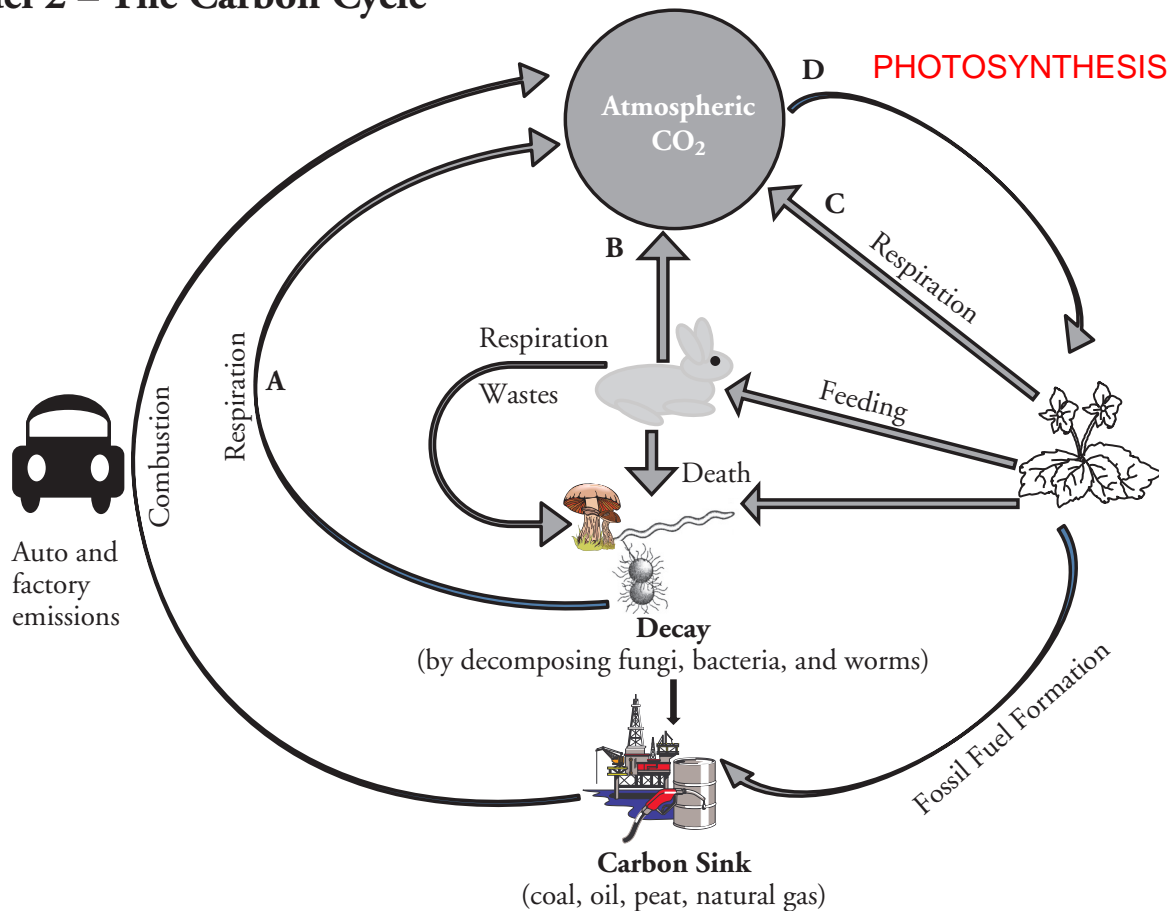
10. The water cycle is a **closed system**, meaning no water enters from beyond the system nor leaves the system. What does that say about the importance of keeping the water on Earth free from pollution?

The water we have is all the water we have. If we don't clean it, the water we have will stay polluted.

Polluted water is useless to us living things.



Model 2 – The Carbon Cycle



11. Model 2 illustrates how nature recycles what natural resource? **CARBON**
12. Name two ways that carbon (usually in the form of CO₂) enters the atmosphere.
ANIMAL, PLANT RESPIRATION
13. Process D on the diagram uses CO₂ from the atmosphere. **PHOTOSYNTHESIS**
 - a. Label D on the diagram in Model 2 with the name of this process.
 - b. What organisms carry out the process identified in part a? **DECOMPOSERS**
14. 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?
DECOMPOSERS
 - b. What would happen if decomposition did not occur?
DISEASE AND INFESTATION WOULD SPREAD



15. 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.

oil, peat, coal, natural gas

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

fossil fuels

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

for combustion to generate energy and move machines

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

cellular respiration

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

car ignition, forest fires, bonfire, turning on natural gas in stove to cook, lighting a match

17. How is the majority of electricity generated in the area where you live? Does the process involve the combustion of coal? Check with your teacher if you are not sure.

hydroelectric power from lakes and dams from Alabama and Georgia

18. 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.

coal, natural gas, gasoline, diesel, machine lubricant oils, peat, petroleum derivatives



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

The combustion of fossil fuels frees carbon in the atmosphere increasing the amount of CO₂ and CO in the air (greenhouse effect)

Read This!

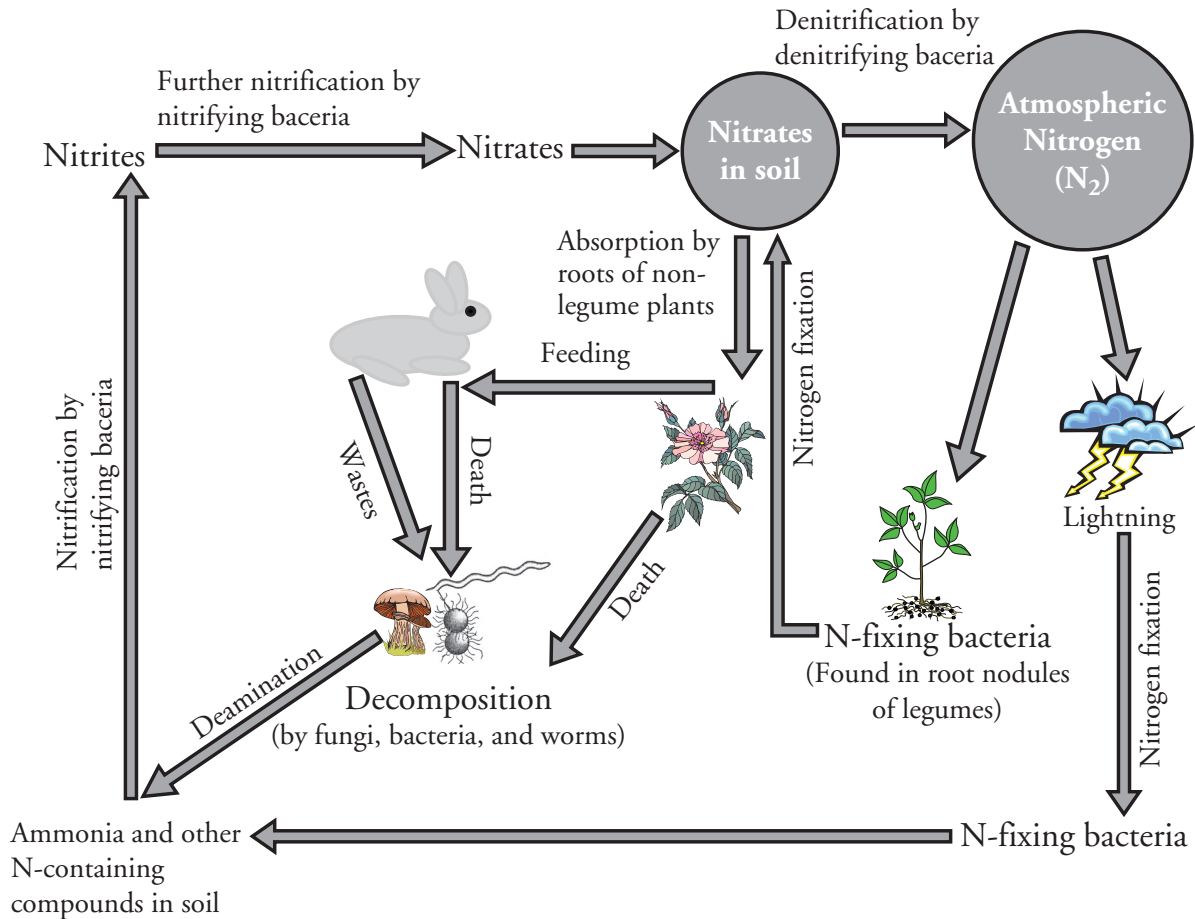
Carbon dioxide (CO₂) is one of the so-called **greenhouse gases**. These gases hold heat energy in the atmosphere, which raises the overall temperature of the Earth. This helps maintain the Earth's biosphere, but also has led to environmental concerns. The more CO₂ in the atmosphere, the higher the Earth's average temperature will be.

20. 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?

DEFORESTATION: By cutting down trees, which remove C from the atmosphere during photosynthesis, we are contributing to the increase in levels of CO₂ in the air. This in turns contributes to the greenhouse effect. (global warming)



Model 3 – The Nitrogen Cycle



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

NITROGEN

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

NITRIFYING BACTERIA, DENITRIFYING BACTERIA, N-FIXING BACTERIA

Read This!

Nitrification is a process by which specific bacteria convert different forms of N-containing compounds (like ammonia, NH_3) in the soil to nitrites (NO_2) and nitrates (NO_3). This process is important since the only forms of nitrogen that are usable by plants to build their proteins are the nitrates.

23. In what ways is N_2 gas removed from the atmosphere?

LIGHTNING AND NITRIFYING BACTERIA

24. By what process are animal wastes and dead organisms converted to other nitrogen-containing compounds?

DECOMPOSITION

25. What is the only form of nitrogen that nonlegume plants can take in and use?

NITRATES IN SOIL

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

THEY CONVERT NITRATES IN SOIL INTO ATMOSPHERIC NITROGEN (N₂)



27. 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?

AMONIA WOULD ACCUMULATE ON THE SOIL, WHICH WOULD HAVE LOW LEVELS OF NITRATES AVAILABLE FOR LIVING THINGS.



Extension Questions

28. Plants and animals are part of all of 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.

ORGANIC COMPOUNDS:

FATS (LIPIDS), SUGARS (CARBOHYDRATES), NUCLEIC ACIDS (DNA AND RNA), PROTEINS

PROTEINS AND NUCLEIC ACIDS BOTH CONTAIN NITROGEN IN THEIR MOLECULAR COMPOSITION. IF WE ARE NOT ABLE TO CONSUME NITRATES IN FOOD, WE'LL BE DEFICIENT IN THOSE ORGANIC COMPOUNDS.

29. 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?

BECAUSE THE ROOTS OF LEGUMINOUS PLANTS SUCH AS BEANS, SOYBEANS AND PEANUTS CONTAIN NITRIFYING BACTERIA, WHICH FIX ATMOSPHERIC NITROGEN (N₂) INTO THE SOIL AND MAKES IT AVAILABLE FOR PLANTS TO GROW AND CONSUMERS TO EAT.