

## Understanding the Carbon and Nitrogen Cycles

1. In your own words, explain why photosynthesis and cellular respiration are considered to be complementary processes.
2. Predict what might happen if forest decomposers, such as soil bacteria and fungi, were killed by a pollutant.
3. Explain how the burning of fossil fuels by humans affects the carbon cycle.
4. Carbon cycles more quickly through some ecosystems than others. Explain why carbon is cycled more slowly in northern ecosystems than in the tropics.

### 5. Table 1 Amount of carbon moved per year

Carbon movement	mass of carbon per year ( $10^{13}$ kg)
from atmosphere to plants	120
from atmosphere to oceans	107
to atmosphere from oceans	105
to atmosphere from soil	60
to atmosphere from plants	60
to atmosphere from burning of fossil fuels	5
to atmosphere from net burning of plants	2
to oceans from runoff	0.4

a) Calculate the amount of carbon entering the atmosphere as carbon dioxide every year and the amount of carbon leaving the atmosphere. Is atmospheric carbon dioxide increasing or decreasing?

b) Scientists have expressed concerns about the burning of the rainforests to clear land for farming. The burning of forests contributes  $2 \times 10^{13}$  kg of carbon yearly. Identify another problem that results from this practice.

6. Make a list of suggestions that would reduce the flow of carbon dioxide into the atmosphere. Which of your suggestions would you be willing to follow?

7. The Canadian government has long considered placing a “carbon tax” on products such as gasoline.

a) Some people believe such a tax would reduce the amount of carbon dioxide entering the atmosphere. Do you agree? Justify your answer.

b) What groups, individuals or businesses would you expect to oppose the tax? Which would you expect to support the tax?

8. Nitrogen is an important element for all organisms.

a) Why is nitrogen important to organisms?

b) How do plants and animals obtain usable nitrogen?

9. Nitrogen-fixing bacteria are found in the roots of bean plants. Explain how the bacteria benefit the plant and how the plant benefits the bacteria.

10. Nitrate levels were analyzed from living material and soil samples in three different ecosystems (grassland, temperate rain forest, and tropical rain forest) in the same month. To determine the mass of nitrates in living things, all living plant matter was collected in a study area and the levels of nitrates were determined. The same analysis was conducted for the top layer of soil. The results are listed in Table 2, where each ecosystem is identified by a number.

**Table 2 Nitrate Content of Three Ecosystems**

Study area	Soil nitrates (kg/ha)	Biomass nitrates (kg/ha)	Soil temperature (°C)
1	30	90	25
2	10	175	19
3	2	270	30
tundra			

- In which community does nitrogen cycle most rapidly? Explain your conclusion.
- Identify each study area as grassland, temperate rain forest, or tropical rain forest. Justify your answers.
- Predict the data that might be collected from a tundra ecosystem. Justify your prediction.

11. With each grain harvest, nitrogen is removed from the field. Some farmers rotate the crops they plant in each field. Farmers alternate a crop that require lots of nitrogen, such as corn, with a legume like alfalfa. Legumes sometimes have less value in the marketplace than crops like corn.

- Why does the amount of nitrogen in fields decline when crops are harvested?
- Why would farmers plant a crop that provides less income?
- Sometimes, farmers plow under the remains of a crop and do not plant a crop for a year. Why would they do this?
- Why has the development of modern fertilizers allowed farmers to abandon the practice of crop rotation?

12. Older lawns often have many denitrifying bacteria. Denitrifying bacteria grow best where there is no oxygen. Why might homeowners decide to aerate their lawn?

13. Denitrification speeds up in ecosystems such as bogs where there is very little oxygen. These ecosystems can support only a few types of plants - those able to live with very low nitrogen concentration. Insect-eating plants, such as sundews and pitcher plants are commonly found in bogs. Explain the presence of these plants in a bog ecosystem.

14. To decrease the amount of carbon dioxide in the atmosphere a group of scientists has proposed adding nitrogen and phosphorus fertilizer to the oceans.

- How would dumping fertilizers in the ocean help reduce carbon dioxide levels?
- What environmental problems could be caused by the approach?