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Vocabulary Words

fixation (fik sã' shən): the process by which certain bacteria change nitrogen in the atmosphere into nitrogen compounds

legume (li' gyüm): any plant of the pea family that has the ability to store up nitrates

nitrates (nī' trāts'): nitrogen compounds that plants need to grow

nodule (nä' jül): a small rounded mass or lump

△ Pronounce these words to someone.

Nitrogen is very important to living things. Without nitrogen, organisms could not make proteins. Proteins are special molecules that animals and humans must have to live and grow.

As you may remember, 78 percent of our atmosphere is nitrogen. However, plants cannot take nitrogen from the air. Nitrogen must be changed from its gaseous form to a nitrogen compound in order for plants to use it.

Fixation

There are particular bacteria called *nitrogen-fixing bacteria*. These bacteria fix (fasten) nitrogen from the air into compounds, forming **nitrates** that can then be used by plants. This is called **fixation**. Plants absorb these nitrates through their roots.

These useful bacteria are always present in the soil. They also multiply in the roots of **legumes**. Legumes are plants such as peas, clover,

alfalfa, peanuts, soybeans, and beans. The roots of legumes have little bumps called **nodules**. Nitrogen-fixing bacteria live inside the little nodules and change nitrogen to nitrates, a form of nitrogen plants can use.

Legumes collect more nitrates than they need. Farmers may improve their soil by planting legumes and then plowing them under at the end of the growing season. This enriches the soil with nitrogen from the nodules.

Did you know that God designed thunderstorms so they would help fertilize the ground? When lightning flashes through the air, it mixes some of the nitrogen in the atmosphere with oxygen to form nitrates. These nitrates then come down in rain and soak into the ground.

Removal

Nitrogen can be removed from the soil in several ways. Plants growing in the soil take some nitrogen from the ground. When these plants die and decompose, the nitrogen is returned. If animals eat the plants, some of the nitrogen is returned to the soil in their manure. This is why farmers often spread manure from livestock on their fields. The rest of the nitrogen is returned to the ground when the animals die and decompose. Although animals need and contribute nitrogen to the soil, the cycle could be completed without them.

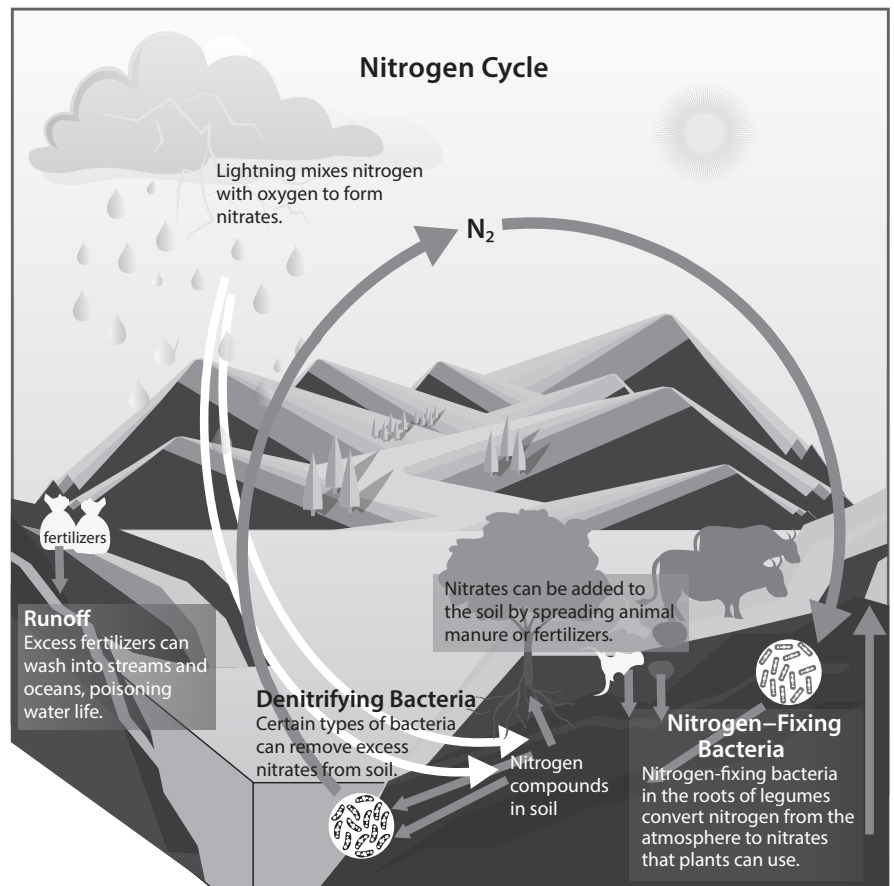
Still another way nitrogen is removed from the soil is by bacteria. Some bacteria fix nitrogen in the soil, but other kinds of bacteria remove it from the



Nodules on legume roots.

soil. The rate at which nitrogen is fixed in the soil usually equals the rate at which bacteria remove it from the soil. This produces a stable amount of nitrogen in the soil. However, in some areas this balance has been upset by using too much artificial fertilizer.

When too much fertilizer is added to the soil, more nitrogen may be added than the bacteria can remove. Then the balance is upset by too many nitrates in the soil. These nitrates can be poisonous to plant and animal life. When it rains, these extra nitrates can wash into streams and rivers and cause fish and other stream life to die. To prevent this from happening, homeowners and farmers must be careful to not apply too much fertilizer to their lawns and fields.



Study Exercises

 Write *true* if the statement is *true* and *false* if it is *false*.

1. _____ Green plants use nitrogen gas from the atmosphere.
2. _____ A clover plant is a legume.
3. _____ Lightning puts nitrates into the soil.
4. _____ There is nitrogen in manure.
5. _____ Animals are not necessary to complete the nitrogen cycle.
6. _____ Some bacteria remove nitrogen from the soil.
7. _____ The more fertilizer in the soil, the better crops will always grow.
8. _____ Nitrates that wash into streams are harmful to fish.

 Answer the questions.

9. What are two ways farmers can build up nitrogen in the soil without using chemical fertilizers?

Lesson 8

10. What is a way to prevent nitrates from washing into streams and rivers?



Complete the statements.

11. Nitrogen is important to living organisms because without it they cannot make _____.
12. Little bumps on the roots of legumes, called _____, turn nitrogen into _____, a form of nitrogen plants can use.
13. Plants like peas, peanuts, and beans are called _____.



Underline the correct choice.

14. **Oxygen, Nitrogen** makes up the most of the atmosphere.
15. Legumes collect **more, less** nitrates than they can use.
16. Planting a crop of legumes will **deplete, enrich** the soil.
17. The rate nitrogen is fixed in the soil is **less than, equals** the rate bacteria removes nitrogen.
18. Man sometimes upsets the nitrogen balance in the soil by using **too much, not enough** fertilizer.

Looking Back



Complete the statements.

19. The imprint or remains of an organism that died many years ago is a _____.
20. Two or more types of atoms together is a _____.
21. Photosynthesis combines carbon dioxide and _____ to make food.
22. During respiration, energy is made when _____ combines with food.
23. Carbon compounds made of once-living organisms are _____.



Write *true* if the statement is *true* and *false* if it is *false*. Correct any false statements.

24. _____ Fossil fuels release *oxygen* into the air.
25. _____ *Decompose* means “to rot or break down.”
26. _____ Plants and animals are necessary for the *carbon* cycle.
27. _____ If there were no plants, the earth would run out of *oxygen*.
28. _____ The amount of carbon dioxide in the atmosphere has *decreased* since the 1800s.



Circle the letter(s) of the answer(s).

29. Which three of these are fossil fuels?
- coal
 - oil
 - wood
 - natural gas
30. Carbon compounds are stored in ?.
- rocks
 - animals
 - oceans
 - all of these
31. When animals decompose, the ? stored in their bodies is released back into the atmosphere.
- oxygen
 - nitrogen
 - carbon
 - carbon dioxide

Did You Know?

- ▶ Man-made fertilizers can be misused, but they are an important part of modern farming. It is believed that without man-made fertilizers, it would be almost impossible to feed the world's people.
- ▶ Because legumes can use the nitrates they produce to make proteins, legumes tend to be higher in protein than many grains like wheat and rice.
- ▶ When extra nitrates wash into rivers and streams, algae can start growing rapidly. Algae can then kill stream life by producing poisons or using up all the oxygen in the water.