

## Pretest/Posttest for determining what students learn from lessons about the Nitrogen Cycle

Instructions for the Teacher

Dear Teacher,

The purpose of this module is to help students learn about the nitrogen cycle. In order to help you with determining what they know and when they know we have included a pre/post test about the Nitrogen Cycle before they participate in formal lessons.

The same test will be administered before the lessons and after it. There should be at least 6 weeks between the pretest and posttests. The best design is to give the pretest, then wait about three weeks to present the lessons, and then give the posttest about three weeks later. This way you will find out how much information students can retain some time after the lesson is taught.

The pretest has been designed so that students who do not know anything about the nitrogen cycle will score low. The *pretest* should not be counted as a grade for student performance. It should only be used for the purposes of the study. The *posttest*, however, can count for a student's course grade if you so desire. Sometimes, students become anxious during the pretest because they don't know any of the information. Reassure them that this is only a measure of what they might know and that they are really not expected to know any of the material yet. Remind them that their scores on the pretest will not count as a school grade.

The pretest/posttests are identical so that you can easily compare student performance before and after the lessons. The test is worth 25 points. Some questions are worth several points because students are asked to supply several answers. On the answer key, we have provided full answers, but you may give students full credit if they write a shorter response that addresses the main idea. If you believe a student has only partially addressed the answer for a question worth one point, you may give half credit.

For each student, multiply the number of questions the student answered correctly out of the 25 by four to obtain a percent. A table of questions is presented on the next page. You can use as many lines of the table as you need to match the class sizes with which you are working.

Additionally, there is a diagram of the nitrogen cycle that students are asked to draw. Determine each student's score by counting each correct idea, concept, or component drawn. Do not count arrows, but count each idea separately. Enter the score (number of correct ideas present) for each student on the following sheet.

Teacher: \_\_\_\_\_

Students who learned about the Nitrogen Cycle the traditional way = "Control Group"					Students who learned about the Nitrogen Cycle using the card set and experimental lessons = "Experimental Group"				
Student #	Pretest # ideas on diagram	Posttest # ideas on diagram	Pretest Score as a %	Posttest Score as a %	Student #	Pretest # ideas on diagram	Posttest # ideas on diagram	Pretest Score as a %	Posttest Score as a %
1a					1b				
2a					2b				
3a					3b				
4a					4b				
5a					5b				
6a					6b				
7a					7b				
8a					8b				
9a					9b				
10a					10b				
11a					11b				
12a					12b				
13a					13b				
14a					14b				
15a					15b				
16a					16b				
17a					17b				
18a					18b				
19a					19b				
20a					20b				
21a					21b				
22a					22b				
23a					23b				
24a					24b				
25a					25b				
26a					26b				
27a					27b				
28a					28b				
29a					29b				
30a					30b				

Name \_\_\_\_\_ **Previous Knowledge of the Nitrogen Cycle** Date \_\_\_\_\_

In the space below on this page, please make a diagram of the nitrogen cycle. Add as many components as you can.

Name \_\_\_\_\_ **Previous Knowledge of the Nitrogen Cycle** Date \_\_\_\_\_

**Multiple Choice**

1. \_\_\_\_\_ What percent of our atmosphere is nitrogen gas?
  - a. Trace amounts
  - b. Less than 1%
  - c. About 7%
  - d. About 20%
  - e. Almost 80%
  - f. More than 98%
  
2. \_\_\_\_\_ Why is nitrogen in short supply for plant growth?
  - a. Because there is so little of it in the atmosphere.
  - b. Because N<sub>2</sub> has strong covalent bonds that don't react easily.
  - c. Because microbes need to convert N<sub>2</sub> to more usable forms.
  - d. a and c
  - e. b and c
  - f. all of the above.

**Short Answer**

3. Name a medical use of nitrogen. \_\_\_\_\_

4 & 5. Name **two** ways nitrogen is used in the food industry.

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6. Describe a nitrogen-related benefit of storms. \_\_\_\_\_

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7 & 8. Bat guano has **two** main uses. What are they? \_\_\_\_\_

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9. Name a human use of nitrogen related to the revolutionary war. \_\_\_\_\_

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10 & 11. Name **two** reasons why nitrous oxides in the atmosphere are a problem.

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12 & 13. Name **two** general human sources for nitrous oxides in the atmosphere. \_\_\_\_\_

\_\_\_\_\_

14. Name a natural source of nitrous oxides in the atmosphere. \_\_\_\_\_

\_\_\_\_\_

15, 16 & 17. Name **three** sources of nitrogen in surface water. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

18. Briefly describe how legumes are special with respect to nitrogen. \_\_\_\_\_

\_\_\_\_\_

19. What helps plants in making use of human or animal waste? \_\_\_\_\_

\_\_\_\_\_

20. Describe the result when excess nitrogen in surface waters reaches the ocean. \_\_\_\_\_

\_\_\_\_\_

21, 22 & 23. Name **three** possible nitrogen-related negative effects to the environment or humans from leaky septic tanks. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

24 & 25. Name two specific health effects of drinking water containing nitrates. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_ **Posttest for the Nitrogen Cycle** Date \_\_\_\_\_

In the space below on this page, please make a diagram of the nitrogen cycle. Add as many components as you can.

Name \_\_\_\_\_ **Posttest for the Nitrogen Cycle** Date \_\_\_\_\_

**Multiple Choice**

1. \_\_\_\_\_ What percent of our atmosphere is nitrogen gas?
  - a. Trace amounts
  - b. Less than 1%
  - c. About 7%
  - d. About 20%
  - e. Almost 80%
  - f. More than 98%
  
2. \_\_\_\_\_ Why is nitrogen in short supply for plant growth?
  - a. Because there is so little of it in the atmosphere.
  - b. Because N<sub>2</sub> has strong covalent bonds that don't react easily.
  - c. Because microbes need to convert N<sub>2</sub> to more usable forms.
  - d. a and c
  - e. b and c
  - f. all of the above.

**Short Answer**

3. Name a medical use of nitrogen. \_\_\_\_\_

4 & 5. Name **two** ways nitrogen is used in the food industry.

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6. Describe a nitrogen-related benefit of storms. \_\_\_\_\_

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7 & 8. Bat guano has **two** main uses. What are they? \_\_\_\_\_

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9. Name a human use of nitrogen related to the revolutionary war. \_\_\_\_\_

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10 & 11. Name **two** reasons why nitrous oxides in the atmosphere are a problem.

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14. Name a natural source of nitrous oxides in the atmosphere. \_\_\_\_\_

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15, 16 & 17. Name **three** sources of nitrogen in surface water. \_\_\_\_\_

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18. Briefly describe how legumes are special with respect to nitrogen. \_\_\_\_\_

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19. What helps plants in making use of human or animal waste? \_\_\_\_\_

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20. Describe the result when excess nitrogen in surface waters reaches the ocean. \_\_\_\_\_

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21, 22 & 23. Name **three** possible nitrogen-related negative effects to the environment or humans from leaky septic tanks. \_\_\_\_\_

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24 & 25. Name two specific health effects of drinking water containing nitrates. \_\_\_\_\_

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## Answer Key for Both Pretest and Posttest

## The Nitrogen Cycle

### Multiple Choice

1. **d** What percent of our atmosphere is nitrogen gas?
  - a. Trace amounts
  - b. Less than 1%
  - c. About 7%
  - c. About 20%
  - d. Almost 80%
  - e. More than 98%
2. **e** Why is nitrogen in short supply for plant growth?
  - a. Because there is so little of it in the atmosphere.
  - b. Because N<sub>2</sub> has strong covalent bonds that don't react easily.
  - c. Because microbes need to convert N<sub>2</sub> to more usable forms.
  - d. a and c
  - e. b and c
  - f. all of the above.

### Short Answer

3. Name a medical use of nitrogen. Any of these or similar: **anesthesia, heart medicine, Viagra**

4 & 5. Name **two** ways nitrogen is used in the food industry.

Any **two** of the following: **an aerosol propellant (as N<sub>2</sub>O) for foods such as whipping cream; in freezing and food packaging as nitrogen gas; nitrite (NO<sub>2</sub><sup>-</sup>) is used as a preservative in meat because of its ability to control bacterial growth, provide flavor, and maintain a pink color.**

6. Describe a nitrogen-related benefit of storms. **Lightning forms nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>), which react with rain to form nitric acid (HNO<sub>3</sub> (aq)), which provides nutrients for plant growth.**

7 & 8. Bat guano has **two** main uses. What are they? **As a source for nitrates for gunpowder or explosives and as a fertilizer.**

9. Name a human use of nitrogen related to the revolutionary war. **Gun powder or fireworks.**

10 & 11. Name **two** reasons why nitrous oxides in the atmosphere are a problem.

**Any two of the following: They can interfere with the ozone layer in the atmosphere and also can result in increased deposition of nitrogenous compounds in the soil and water increasing the nitrogen load in the ecosystem. They also contribute to the greenhouse effect and global warming.**

12 & 13. Name **two** general human sources for nitrous oxides in the atmosphere. **Nitrogen oxide (NO<sub>x</sub>) emissions from cars and industrial processes.**

14. Name a natural source of nitrous oxides in the atmosphere. **One of the following: Lightning or the gases released from denitrification by anaerobic bacteria.**

15, 16 & 17. Name **three** sources of nitrogen in surface water. **Any three of the following: sewage effluents, agricultural runoff, industrial effluents, pet droppings, wildlife (bat guano, wild animal/ geese droppings).**

18. Briefly describe how legumes are special with respect to nitrogen. **Legumes utilize nitrogen gas with rhizomes and fungi to manufacture ammonia (NH<sub>3</sub>) and then process the ammonia to form organic nitrogen that is usable by the plant.**

19. What helps plants in making use of human or animal waste? **Organic nitrogen from animal and human waste is transformed by microbes to ammonium and then to nitrate that is usable by plants.**

20. Describe the result when excess nitrogen in surface waters reaches the ocean. **An overabundance of nutrients can trigger excessive algal growth (or eutrophication), which results in reduced sunlight, loss of aquatic habitat, and a decrease in oxygen dissolved in the water. There is a dead zone at the mouth of the Mississippi River in the Gulf of Mexico that is impacted by hypoxia caused by an overabundance of nutrients, including nitrogen.**

21, 22 & 23. Name **three** possible nitrogen-related negative effects to the environment or

humans from leaky septic tanks. **Three of the following: Sewage effluent from improperly maintained septic systems or leaky wastewater lines can also result in nutrients and bacteria reaching surface and ground water. The nutrients in these wastes can result in massive fish kills or toxic algal blooms. Leakage from septic systems can also impact ground water and cause an increase in nitrate with resulting potential health effects.**

24 & 25. Name two specific health effects of drinking water containing nitrates. Any two of the following: **Infants that drink water or formula mixed with high nitrate water can develop methemoglobinemia otherwise known as blue baby syndrome. Young livestock also will develop health problems if they drink water with nitrate-nitrogen or eat high-nitrogen forage. High-nitrate water, vegetables, or meats may be responsible for some cancers.**