Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Student Exploration:** **Plants and Snails**

**Vocabulary**: aerobic respiration, bromothymol blue (BTB), carbon dioxide-oxygen cycle, indicator, interdependence, photosynthesis

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

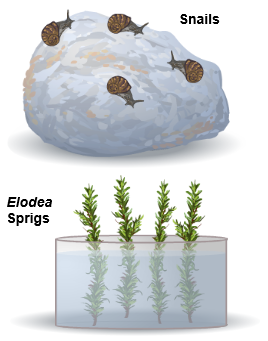
1. What important gas do we take in when we breathe?

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1. Why don’t we run out of the important gases that we need to stay alive?

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**Gizmo Warm-up**

In the *Plants and Snails* Gizmo, each of the test tubes contains water and a small amount of **bromothymol blue** (BTB). BTB is a chemical **indicator**. An indicator changes color when the chemicals in the water change.

1. With the lights set to **on**, drag a snail into one test tube and a plant into another. Press **Play** (**Play**). After 24 hours, what is the color of each tube?

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1. Select **Show oxygen and CO2 values**. Place the **O2/CO2 probe** in each tube. The probe shows the levels of two gases, oxygen (O2) and carbon dioxide (CO2), in the tubes. We call these amounts the *gas levels*.
   1. When the water turns blue, which gas is most common? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. When the water turns yellow, which gas is most common? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. What does it tell you when the water is green? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Activity A:**  **Gases in and gases out** | Get the Gizmo ready:   * Click **Reset** (Reset). * Clear all of the test tubes. * Turn on **Show oxygen and CO2 values**. | 641SE2 |

**Question: What gases do plants and animals take in and what do they give off?**

1. Collect data: Use the Gizmo to learn what gases plants and animals take in and give off. Try it in both light and dark. Record your results below. If you do more than five experiments, write your extra results in your notebook or on separate sheets of paper.

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| **What is in the tube** | **Lights: on/off** | **Results** |
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1. Analyze: Study your data on gases given off by plants.
   1. What gas do plants give off in the light? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. How about in the dark? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Analyze: Study your data on gases given off by animals.
   1. What gas do animals give off in the light? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. How about in the dark? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. How do these results compare to your plant results? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Infer: Describe the **carbon dioxide-oxygen cycle** by completing the sentences below:

*Animals breathe in ­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and breathe out \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

*In sunlight, plants take in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and release \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

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| **Activity B:**  **Interdependence** | Get the Gizmo ready:   * Click **Reset**. * Clear all of the test tubes. * Turn the light switch to **on**. * Check **Show oxygen and CO2 values**. | 641SE3 |

**Question: How do plants and animals depend on each other?**

1. Observe: Put one sprig of Elodea and one snail in a test tube with the lights **on**. Click **Play**.
   1. Does the color of the water in the tube change? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. What happens to the O2 and CO2 levels? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Predict: Without using the Gizmo, predict what you think will happen to the gas levels in each case listed below. (Leave the **Actual result** column blank for now.)

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| **Tube** | **Prediction** | **Actual result** |
| 2 snails, 2 sprigs,  lights on |  |  |
| 1 snail, 2 sprigs,  lights on |  |  |
| 1 snail, 2 sprigs,  lights off |  |  |

1. Run Gizmo: Now run the Gizmo to test your predictions. Record your findings in the table.
2. Generalize: Describe how plants and animals each contribute to the survival of the other. (This type of cooperative relationship is called **interdependence**.)

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1. Challenge: Simulate a 24-hour day (12 hours of light, 12 hours of dark). How many snails and plants do you need to keep a stable environment? Explain any discoveries you make.

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| **Activity C:**  **The carbon-oxygen balance** | Get the Gizmo ready:   * Click **Reset**. * Clear all of the test tubes. * Turn the light switch to **on**. * Check **Show oxygen and CO2 values**. | 641SE4 |

**Question: How are the amounts of oxygen and carbon dioxide related to each other?**

1. Observe: Put two Elodea sprigs into a test tube. Put the **O2/CO2 probe** into the tube with the Elodea. Click **Play**. As the Gizmo runs, **Pause** (Pause) it a few times.
2. How do the oxygen (O2) and carbon dioxide (CO2) levels change over time?

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1. What is always true about the *total* amount of O2 and CO2 in the test tube?

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1. What happens when the CO2 reaches zero? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Revise and repeat: Click **Reset** and run the experiment again, this time with the lights off.
3. How do the gas levels change? O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the total of O2 and CO2? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Revise and repeat: Click **Reset**. Remove the plants. Repeat the experiment with two snails.
6. How do the gas levels change? O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. What is the total of O2 and CO2? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. Challenge: In the process of **photosynthesis**, plants use carbon dioxide (CO2), water (H2O), and light energy to produce a sugar (C6H12O6) and oxygen (O2). In the process of **aerobic respiration**, animals and plants release energy from sugar and oxygen and produce carbon dioxide and water. The chemical equations that describe these reactions look like this:

6CO2 + 6H2O + light 🡪 C6H12O6 + 6O2 C6H12O6 + 6O2 🡪 6CO2 + 6H2O + energy

How do these equations explain why the total amount of O2 and CO2 remains the same?

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