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Background

Photosynthesis is the process that plants and other organisms use to convert light energy from the sun into a useable, chemical energy stored in a molecule called ATP. In turn, the energy provided by the ATP drives a process called the Calvin Cycle, which produces carbohydrates that store energy for the organism to use. Mitochondria provide a method of releasing the stored energy through a process called cellular respiration.

Photosynthesis

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Cellular Respiration

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$

O_2	oxygen gas
CO_2	carbon dioxide
H_2O	water
$C_6H_{12}O_6$	sugar

The chemical equations for photosynthesis and cellular respiration are shown on the left. The molecules on the left side of the arrow are reactants, or the substances that go into a chemical reaction. The molecules on the right side of the arrow are products, or the substances that result from a chemical reaction. What is similar, and what is different about the two equations? What is the relationship between the reactants and products of the two processes?

Notice that the resulting products of photosynthesis (sugar and oxygen) are the reactants needed to begin cellular respiration, and vise versa. In this way, cellular respiration is the reverse of photosynthesis.

Imagine a planet with thin amounts of oxygen–in other words, there would be very few livings things on this planet. The process of photosynthesis allows plants to convert light energy into usable food, removes carbon dioxide from the atmosphere, and releases oxygen into our atmosphere.

Without plants that perform photosynthesis, the oxygen on our planet would run out, and all humans (and other living things that need oxygen) would choke in a carbon-dioxide rich atmosphere.

Use the Background and Student Reference Sheet to answer the Student Journal questions.

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Part I: Plan Your Investigation

1. In this investigation, you will observe how the reactants of photosynthesis and products of cellular respiration cycle between plants and animals. You will do this by examining changes in the color of bromothymol blue (BTB) solutions that will contain a mixture of Elodea plants and freshwater snails.

2. To begin this investigation, come up with a Question of Inquiry that the entire class will use. By having a common Question of Inquiry, the class will be able to compare all the data collected by all the groups. With your class and teacher, discuss the Question of Inquiry and then list the materials that you will need to conduct your investigation.

3. After the class has agreed upon a Question of Inquiry, the class should then determine the hypothesis that will be tested by the class. Again, in order for the class to be able to compare their data, all of the groups must test the same hypothesis. Once a hypothesis is decided, state both the independent and dependent variables that will be used in the experiment.

4. Within your groups, discuss any safety precautions you need to take for this investigation and record them in your Student Journal. Remember that you will be working with chemicals, so make sure to list all safety equipment that will be required. Also, make sure to discuss with your teacher the proper protocols for the disposal of the BTB solutions and the snails.

5. Finally, you will create a list of procedures to conduct this experiment. List how you will set up the test tubes for each sample, what type of treatment they will receive, and how long the test tubes will sit until observation. Then, during the next class period, you will make observations, record your data, and analyze what you have observed.

6. Once you have completed the investigation, recorded all of your data, and completed your Student Journal, return all materials as directed by your teacher.

Complete Part I of your Student Journal.

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Part II: Implement Your Investigation

Procedure: Light Set Up

Using masking tape, make four labels as follows:

Tube L1 BTB Only Period: Group:	Tube L2 *Elodea* Period: Group:	Tube L3 1 Snail Period: Group:	Tube L4 *Elodea*, Snail Period: Group:

1. Add water to each test tube until about ¾ full.
2. Add Add 5 drops of BTB solution to each test tube.
3. Using the straw, have one person gently blow into each test tube until the color changes to green.
4. Insert a stopper into the mouth of test tube L1 and place it in the test tube rack.
5. Add a sprig of *Elodea* to test tube L2 and insert a stopper into the mouth of the test tube. Place the test tube in the test tube rack.
6. Carefully add one snail to test tube L3 and insert a stopper into the mouth of the test tube.
7. Place the test tube in the test tube rack.
8. Add a sprig of *Elodea* and one snail to test tube L4. Insert a stopper into the mouth of the test tube and place the test tube in the test tube rack.
9. Set the test tube rack in an area exposed to light according to your teacher's directions.

Complete Part II of your Student Journal.

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Part II: Implement Your Investigation, continued

Procedure: Dark Set Up

Using masking tape, make four labels as follows:

Tube D1 BTB Only Period: Group:	Tube D2 *Elodea* Period: Group:	Tube D3 1 Snail Period: Group:	Tube D4 *Elodea*, Snail Period: Group:

1. Add water to each test tube until about ¾ full.
2. Add 5 drops of BTB solution to each test tube.
3. Using the straw, have one person gently blow into each test tube until the color changes to green.
4. Insert a stopper into the mouth of test tube L1. Wrap the test tube with aluminum foil so that no light can get through. Place the test tube in the test tube rack.
5. Add a sprig of *Elodea* to test tube L2 and insert a stopper into the mouth of the test tube. Wrap the test tube with aluminum foil so that no light can get through. Place the test tube in the test tube rack.
6. Carefully add one snail to test tube L3 and insert a stopper into the mouth of the test tube. Wrap the test tube with aluminum foil so that no light can get through. Place the test tube in the test tube rack.
7. Add a sprig of *Elodea* and one snail to test tube L4. Insert a stopper into the mouth of the test tube. Wrap the test tube with aluminum foil so that no light can get through. Place the test tube in the test tube rack.
8. Set the test tube rack in an area designated by your teacher.

Complete Part II and the Reflections and Conclusions of your Student Journal.