Lab: Investigating Cellular Respiration and Photosynthesis

Name(s) _______________________________ Date ____________
Period_________

Benchmarks:
SC.912.L.18.8: Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.
SC.912.L.18.9: Explain the interrelated nature of photosynthesis and cellular respiration.

Background:
ALL living organisms carry out the process of cellular respiration: the process in which energy is released from the chemical bonds of glucose. However, ONLY autotrophs carry out the food making process called photosynthesis. Green plants are examples of autotrophs, meaning they can make their own food in the form of carbohydrates (products) by combining the reactants of carbon dioxide (CO₂) and water (H₂O) with the aid of solar energy. Oxygen is a fortunate by-product of this process.
To release the energy contained in the bonds of carbohydrate molecules, the chemical reaction of photosynthesis must be reversed in a process called cellular respiration. Because all living things need a constant flow of energy, the process of cellular respiration is always taking place.
In addition to energy production, cellular respiration produces the waste products: carbon dioxide and water; which are the same substances that served as the reactants for photosynthesis.

Indicators: The following can be used as pH indicators:
Phenol Red-changes from red to orange in the presence of carbonic acid.
Bromothymol Blue-changes from blue to green to yellow in the presence of carbonic acid.
Purple cabbage juice-changes from purple to red in the presence of carbonic acid.

The following 2 experiments will demonstrate the relationship between the processes of photosynthesis and respiration. Read through the lab procedure and answer the following questions prior to beginning the lab.

1. What is an acid indicator? ________________________________________________________
   ______________________________________________________________________________

2. In Part B, why is nothing added to one of the test tubes containing pH indicator? _____________
   ______________________________________________________________________________

3. What special safety note should you observe when you blow through the straw? _____________
   ______________________________________________________________________________

Purpose:
To understand the relationship between photosynthesis and respiration.
To observe how respiration occurs under aerobic conditions.

Hypothesis:
Read the entire investigation. Then work with your partner to develop a hypothesis for both Part A and Part B.

   1. Hypothesis Part A: ______________________________________________________________
      ______________________________________________________________________________
2. Hypothesis Part B: _____________________________________________________________
____________________________________________________________________________

Materials – Parts A and B:
- Safety Goggles
- Gloves
- Coffee Stir Straw
- pH Indicator = Diluted Phenol Red, Bromothymol Blue, or Purple Cabbage Juice
- 10mL Graduated Cylinder
- Test Tube Rack
- 4 – Test Tubes (15x125mm)
- Parafilm or plastic-wrap
- Wax Pencil/Marker
- 10 seedlings (radish/bean sprouts)
- 4cm Sprig of Elodea, Evergreen, or Pond-weed
- Light Source
- Cotton-balls
- Scissors

1. Be sure to wear your safety goggles throughout this lab.
2. Label the 4 test tubes; 1, 2, 3, and 4.
3. Measure 7 mL of pH indicator into test tube #1 and repeat for test tube #2 (each will be about ½ full).
4. Seal one test tube #1 with parafilm or plastic wrap and place it in your test tube rack. Note its color on the Data Table.
5. Insert a small, coffee stir-straw into test tube #2 and cover temporarily with parafilm.
6. VERY CAREFULLY blow into the straw in test tube #2 until the pH indicator changes color. Be careful to prevent any liquid from bubbling out of the test tube and onto your face or clothes. **CAUTION: DO NOT inhale any of the pH indicator**
7. Record the color of the pH indicator in each test tube in the Day 1 column on the Data Table.
8. Cut a 4cm sprig of Elodea (or other available plant) into test tube #2 and cover with parafilm.
9. Place near a bright light source.
10. After 24 hours (or during your next class), observe test tube #1 and #2; record a brief description of the reaction in the "Description" column on the Data Table. Also note the final color of the pH indicator.

Procedure – Part B: Products of Cellular Respiration
1. Measure 4 mL of the same type of pH indicator used in Part A, into test tube #3 and repeat for test tube #4.
2. Cut a cotton-ball in half.
3. Place a half-cotton-ball into test tube #3 so that it is just above the pH indicator and repeat for test tube #4.
4. Place 10 seedlings into test tube #3 and cover with parafilm.
5. Cover test tube #4 with parafilm (no seedlings).
6. Record the color of the pH indicator in test tube #3 and #4 on the Data Table.
7. Place the test tubes in a test-tube rack and place in dark location for 24 hours (or until next class).
8. After 24 hours (or during your next class), observe test tube #3 and #4; record a brief description of the reaction in the "Description" column on the Data Table. Also note the final color of the pH indicator.
Data:

Data Table – Part A & Part B – Observations (pre and post)

<table>
<thead>
<tr>
<th>Test-Tube</th>
<th>Description of Reactions</th>
<th>Color of pH indicator (Day 1)</th>
<th>Color of pH indicator (Day 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>2</td>
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<td>4</td>
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</tbody>
</table>

Analysis:

1. Describe what caused the color change of the pH indicator when you exhaled into the test tube.

____________________________________________________________________________
____________________________________________________________________________

2. After 24 hours, did the color of the pH indicator in test tube #2 change? Explain.

____________________________________________________________________________
____________________________________________________________________________

3. After 24 hours, did the color of the pH indicator change in test tube #3? Explain.

____________________________________________________________________________
____________________________________________________________________________

4. **Compare / Contrast:** Compare the reaction that occurred in test tube #3 to the reaction that occurred in the test tube #2. How are they similar / different? ______________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

5. **Inferring:** Which test tube exhibited the process of respiration? Explain.

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
6. In part A, which test tube was the control? What is the function of your control?
____________________________________________________________________________
____________________________________________________________________________

Conclusion:

1. **Hypothesis:** Were your hypothesis correct or incorrect? Explain your answer in detail.
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____________________________________________________________________________
____________________________________________________________________________
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____________________________________________________________________________
____________________________________________________________________________

2. **Drawing Conclusions:** Why is the process of cellular respiration necessary for all forms of life?
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____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

3. Write the formulas for photosynthesis and respiration below:
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
In your own words, explain the relationship between the two processes. ________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________