Name: _____ Date: _____

Student Exploration: Photosynthesis Lab

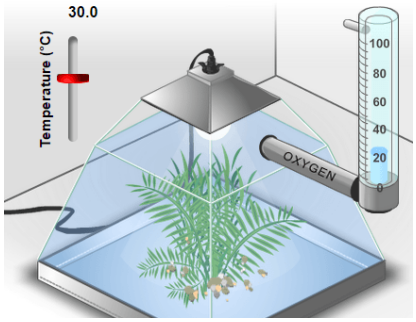
Vocabulary: carbon dioxide, chlorophyll, glucose, limiting factor, nanometer, photosynthesis, wavelength

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

- To survive, what gas do we need to breathe in? _____
- Where is this gas produced? _____

Gizmo Warm-up

During **photosynthesis**, plants use the energy of light to produce **glucose** ($C_6H_{12}O_6$) from **carbon dioxide** (CO_2), and water (H_2O). Glucose is a simple sugar that plants use for energy and as a building block for larger molecules.



A by-product of photosynthesis is oxygen. Plants use some of the oxygen they produce, but most of it is released. In the *Photosynthesis Lab* Gizmo™, you can monitor the rate of photosynthesis by measuring oxygen production.

1. Observe the left pane closely. What do you think the bubbles are? _____

2. Select the BAR CHART tab. On the graph, notice the **Oxygen flow** bar. Move the **Light intensity** slider back and forth. How does light intensity affect oxygen production?

   _____

3. Experiment with the vertical **Temperature** slider (upper left) and the **CO_2 level** slider.

   A. How does temperature affect oxygen production? _____

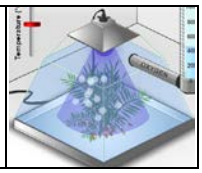
   _____

   B. How does CO_2 level affect oxygen production? _____

   _____

   C. How does oxygen production relate to the rate of photosynthesis? _____

   _____

Activity A: **Colored light**	Get the Gizmo ready: • Select the COLOR tab and the BAR CHART tab. • Set the **Temperature** to 24°C, the **Light intensity** to 90%, and the **CO_2 level** to 1,000 ppm.	

Introduction: Plants use a green pigment called **chlorophyll** to absorb light and convert its energy into a form that the plant can use. Chlorophyll gives plants their green color.

Question: What color of light is the best for photosynthesis?

1. Observe: The color of a light wave is determined by its **wavelength**. On the COLOR tab, slowly drag the **Light wavelength** slider back and forth and observe the effect on oxygen production. How does the color of light affect the rate of photosynthesis?

   _____

   _____

2. Form hypothesis: Which color of light do you think will maximize the rate of photosynthesis?

   _____

3. Gather data: Set the **Light wavelength** to 400 nm. (The symbol "nm" stands for **nanometers**. A nanometer is a billionth of a meter.) Visible light ranges from 400 to 700 nm.

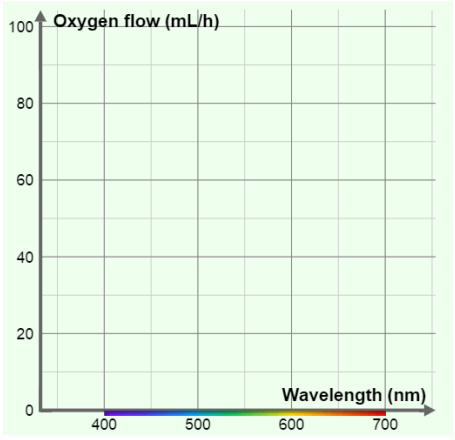
   On the TABLE tab, click **Record data**. Then set the **Light wavelength** to 420 nm, and repeat. Continue recording data in the Gizmo every 20 nm until the wavelength is 700 nm.

4. Make a graph: Select the GRAPH tab and select **Wavelength**. Sketch the graph in the space at right.

   A. Which colors were absorbed best by the plant? _____

   B. Which colors were absorbed worst?

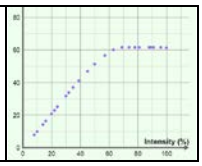
   _____



5. When we look at a leaf, we see the colors of light that are reflected off its surface. How does this explain the relatively low flow of oxygen in green light?

   _____

   _____

Activity B: **Limiting factors**	Get the Gizmo ready: • Select the WHITE tab and the BAR CHART tab. • Turn on **Show numerical values**.	

Introduction: Photosynthesis requires light, water, and CO_2 to work. When one of these factors is in short supply, it is called a **limiting factor**. Temperature can also be a limiting factor when it is too hot or too cold for photosynthesis to work well.

Question: What is the effect of limiting factors on photosynthesis?

1. Observe: Set **Temperature** to 24°C, **Light intensity** to 50%, and **CO_2 level** to 200 ppm.
   A. Move the **Temperature** slider up and down. Were you able to increase oxygen production? _____ (Return the slider to 24°C when finished.)
   B. Move the **Light intensity** slider back and forth. Were you able to increase oxygen production? _____ (Return the slider to 50% when finished.)
   C. Move the **CO_2 level** slider back and forth. Were you able to increase oxygen production? _____ (Return the slider to 200 ppm when finished.)

2. Analyze: In this situation, what was the limiting factor? _____

   How do you know? _____

   _____

3. Challenge: In each of the situations below, use the Gizmo to find the limiting factor.

Temperature	Light intensity	CO_2 level	Limiting factor
25°C	60%	700 ppm	
15°C	20%	200 ppm	
30°C	50%	400 ppm	

4. Think and discuss: Suppose you were a farmer trying to grow plants in a greenhouse. Why would it be important to know what the limiting factor is?

   _____

   _____