

Name: _____ Date: _____ Period: _____

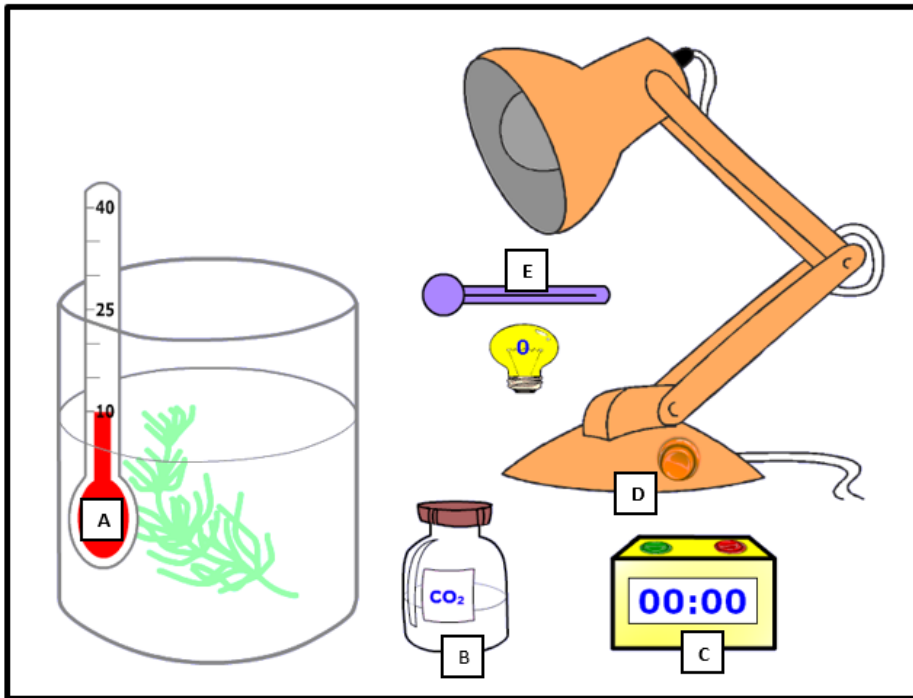
PHOTOSYNTHESIS: LIMITING FACTORS

Purpose:

1. To determine the effect of temperature, light intensity, and light color on the rate of photosynthesis.
2. To calculate the rate of photosynthesis by measuring the number of oxygen bubbles produced in 30 second intervals.

Directions:

1. The virtual lab can be accessed at the following site: <http://www.kscience.co.uk/animations/photolab.htm>
2. The lab set up is pictured below. Look at the diagram in order to know how to manipulate (change) the variables.



- A. Click on the thermometer to change Temperature of the water.
- B. Click on the CO₂ bottle to increase Or decrease the amount of CO₂ in The water.
- C. Click the green button to start and Stop the timer. Red button to reset.
- D. Click the orange button to change the color of the light bulb.
- E. Slide the circle across the bar to change the light intensity. The intensity will be seen as a percentage in the light bulb below.

Experimental Design:

1. Based on the resources available, what are some possible variables that could be tested?

2. How many variables can you change in a single experiment? Explain your response.

3. What is our dependent variable? _____

4. Is the data being collected in the experiment qualitative or quantitative? _____



Experiment 1: How does temperature affect the rate of photosynthesis?

Procedure:

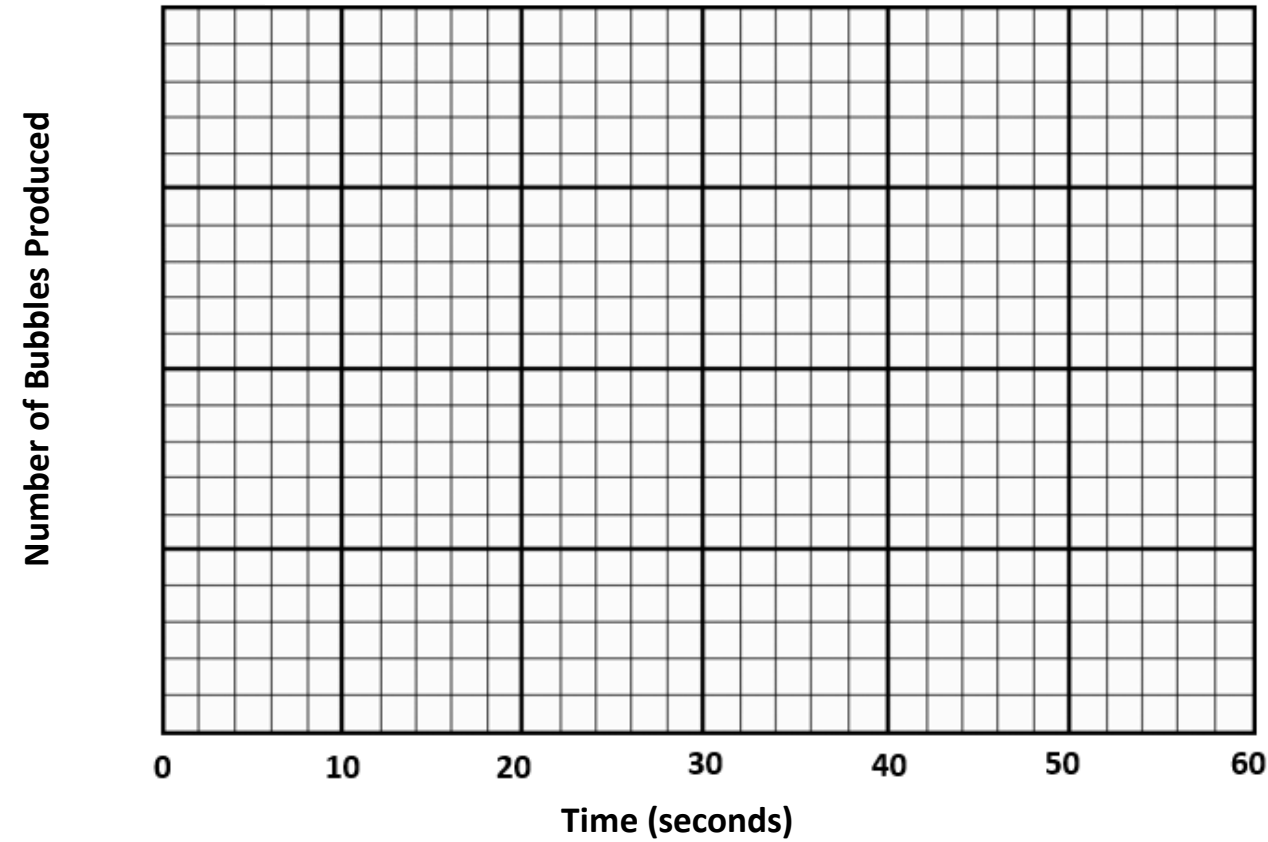
- 1. Click on the bottle of CO₂ to add it to the solution.
- 2. Set the light intensity to 50%.
- 3. Start the timer by clicking the green button and count the number of bubbles that appear after 10 seconds.
- 4. Continue collecting data for one minute. **Counting is continuous—Do not start over.**
- 5. Increase the temperature to 25° by clicking on the thermometer and repeat step 3-4.
- 6. Increase the temperature to 40° by clicking on the thermometer and repeat step 3-4.

Data:

Independent Variable: _____ Dependent Variable: _____

	10 seconds	20 seconds	30 seconds	40 seconds	50 seconds	60 seconds
10° C						
25° C						
40° C						

The Effect of Temperature on Photosynthesis over Time



Experiment 2: How does light intensity affect the rate of photosynthesis?

Procedure:

1. Click on the bottle of CO₂ to add it to the solution.
2. Click on the thermometer to set the temperature to 25°C
3. Set the light intensity to 15%.
4. Start the timer by clicking the green button and count the number of bubbles that appear after 10 seconds.
5. Continue collecting data for one minute. **Counting is continuous—Do not start over.**
5. Increase the light intensity to 30% and repeat steps 4-5.
6. Increase the light intensity to 50% and repeat steps 4-5.

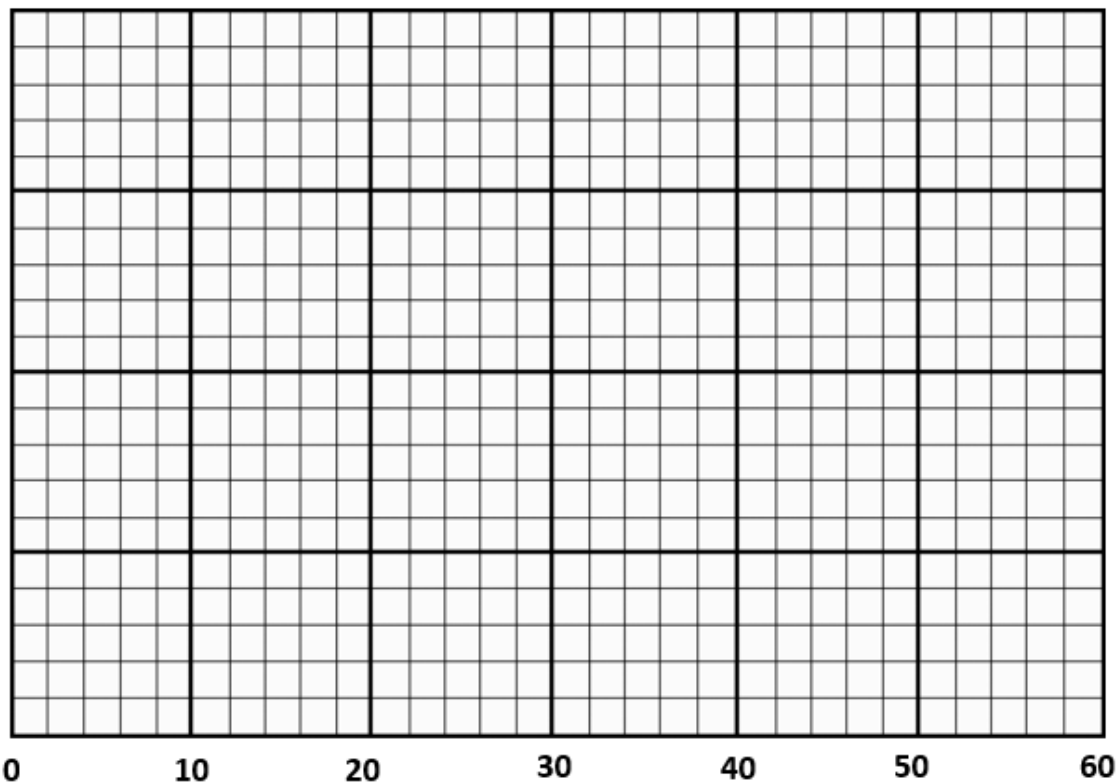
Data:

Independent Variable: _____ Dependent Variable: _____

	10 seconds	20 seconds	30 seconds	40 seconds	50 seconds	60 seconds
15% light						
30% light						
50% light						

TITLE: _____

Label: _____



Label: _____

Experiment 3: How does the color of light affect the rate of photosynthesis?

Procedure:

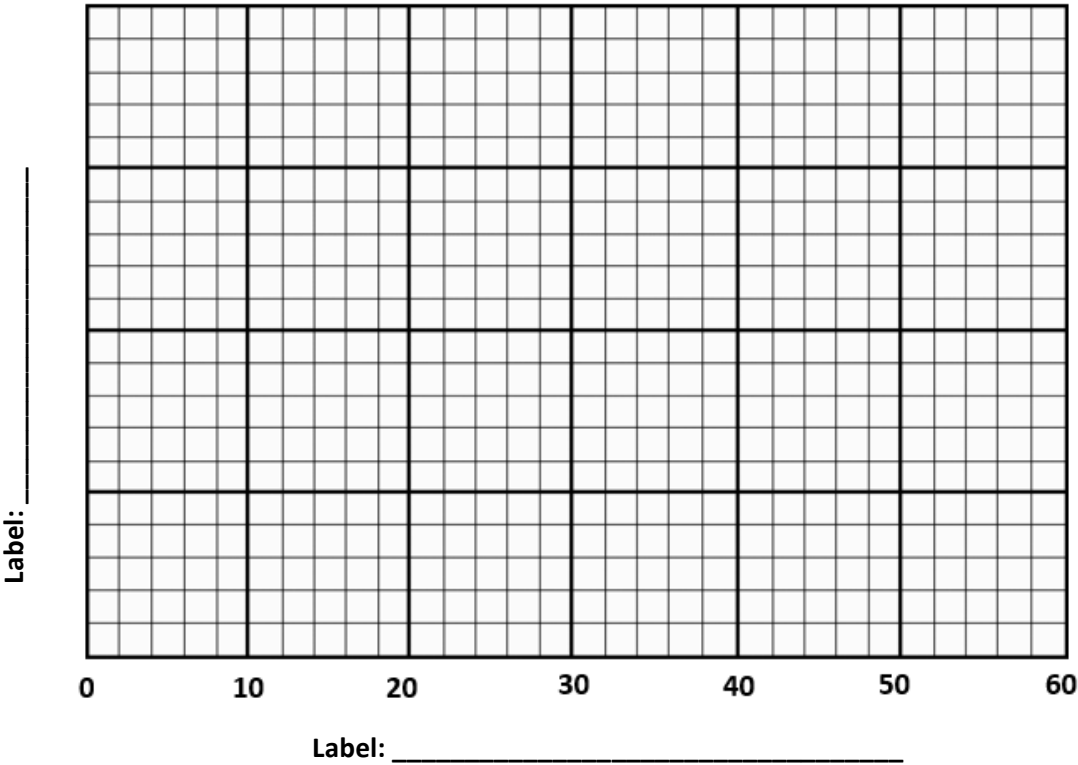
- 1. Click on the bottle of CO₂ to add it to the solution.
- 2. Click on the thermometer to set the temperature to 25°C
- 3. Set the light intensity to 50%.
- 4. Click the button on the light to change the bulb color to orange.
- 5. Start the timer by clicking the green button and count the number of bubbles that appear after 10 seconds.
- 6. Continue collecting data for one minute. **Counting is continuous—Do not start over.**
- 7. Change the light color to green and repeat steps 5-6.
- 8. Change the light color to blue and repeat steps 5-6.

Data:

Independent Variable: _____ Dependent Variable: _____

	10 seconds	20 seconds	30 seconds	40 seconds	50 seconds	60 seconds
Orange						
Green						
Blue						

TITLE: _____



Analysis and Conclusion: Self-Quiz

1. ____ What type of gas bubble are being produced?
 - A. Carbon Dioxide
 - B. Oxygen
 - C. Nitrogen
 - D. This cannot be determined
2. ____ All of the following were used as independent variables in this activity EXCEPT:
 - A. The number of oxygen bubbles
 - B. Temperature
 - C. Light Color
 - D. Light Intensity
3. ____ Which of the following best explains why carbon dioxide must be added to the water?
 - A. Carbon dioxide bubbles can't be produced if it is not added to the solution
 - B. Carbon dioxide maintains the green color seen in the plant
 - C. Carbon dioxide is a needed reactant (input) of photosynthesis
 - D. Carbon dioxide does not need to be added
4. ____ Where would aquatic plants obtain the carbon dioxide needed to perform photosynthesis?
 - A. Aquatic animals that exhale carbon dioxide.
 - B. Other aquatic plants that produce carbon dioxide through photosynthesis
 - C. Carbon dioxide diffuses into the water molecules
 - D. Water breaks down into carbon dioxide and hydrogen
5. ____ Which of the following best explains the effect of temperature on photosynthesis?
 - A. Temperature does not affect the rate of photosynthesis
 - B. Photosynthesis occurred at its highest rate at 10°C
 - C. Photosynthesis occurred at its highest rate at 25°C
 - D. Photosynthesis occurred at its highest rate at 40°C
6. ____ Which of the following best explains the effect of light intensity on photosynthesis?
 - A. The lower the light intensity, the higher the rate of photosynthesis
 - B. The intensity of light is inversely proportionate to the rate of photosynthesis
 - C. The light intensity does not affect the rate of photosynthesis
 - D. There is a direct relationship between light intensity and the rate of photosynthesis.
7. ____ Which of the following best explains the effect of light color on photosynthesis?
 - A. Blue light results in the highest rate of photosynthesis.
 - B. Green light results in the highest rate of photosynthesis.
 - C. Orange light results in the highest rate of photosynthesis.
 - D. Both blue light and green light produce the highest rate of photosynthesis.
8. ____ Which of the following scenarios would produce the highest rate of photosynthesis?
 - A. Orange light at 30% intensity at a temperature of 40°C
 - B. Green light at 50% intensity at a temperature of 25°C
 - C. White light at 15% intensity at a temperature of 10 °C
 - D. Blue light at 50% intensity at a temperature of 25°C

