Photosynthesis

A Carolina Essentials™ Investigation

Student Worksheet

Overview

Photosynthesis is the principle way in which radiant energy is converted to organic substances stored for use in growth, reproduction, and metabolism in plants. Sunlight, carbon dioxide, and water react to form the sugars that plants use for metabolism.

The chemical bromothymol blue is a pH indicator that appears blue in alkaline (basic) conditions and yellow-green in acidic conditions. For this investigation, carbon dioxide (CO_2) has already been added to the bromothymol blue solution, turning the bromothymol blue yellow-green. The reaction of carbon dioxide with water forms carbonic acid in equilibrium, indicating the reaction is going both directions at all times. If CO_2 is removed from the system, more carbonic acid will dissociate until the system reaches equilibrium again:

$$CO_{2(g)} + H_2O_{(l)} \rightleftharpoons H_2CO_{3(aq)}$$

As carbon dioxide is removed from the solution through photosynthesis, the solution will become more basic and change from yellow to dark green and then to blue.

SAFETY REQUIREMENTS

MATERIALS

Diluted 0.04% bromothymol blue solution, 200 mL

2 6-cm sprigs of *Elodea*

Aluminum foil, 20 cm x 10 cm

Marker or wax pencil

2 culture tubes with caps

1 7-mL dropping pipet

Paper towels

Light bank (if there is no access to natural sunlight)

Essential Question

What is photosynthesis and what substances are used (reactants) and created (products) during the process?

Investigation Objectives

1. Describe the process of photosynthesis and indicators that it takes place.
2. Explain how carbon dioxide use during photosynthesis can be quantified.

Safety Procedures and Precautions

Bromothymol blue will stain your hands and clothing. Wear gloves and goggles and practice safe laboratory procedures when performing this activity.

Procedure

1. With a permanent marker or wax pencil, write your initials (or other mark to identify your group) on the capped tubes. Toward the top of a tube, write “D” for dark. On the other tube write “L” for light.
2. Obtain two 6-cm sprigs of *Elodea* and place a sprig in each of the tubes.
3. While working over a paper towel, use the dropping pipet to fill both tubes to overflowing with the yellow-green bromothymol blue solution and cap both tightly. Clean up any spills.
4. Quickly make observations of both tubes.
5. Immediately wrap the tube marked “D” with aluminum foil so the tube is completely covered to prevent any light from reaching the *Elodea*.
6. Place both tubes in the sunlight or under a light bank.
7. Wait 1 hour or the time designated by your teacher. Record your observations.

Disposal

Dispose of all materials per your teacher’s instructions.

Continued on the next page.

Data Table

Light	Dark
Before	
After	

Analysis

1. Describe and compare the color of the bromothymol blue solution in the tubes.

2. Explain the chemistry behind any color change that has occurred in any tube.

3. Summarize the process of photosynthesis using chemical formulas and a color coding scheme that matches lab data.