Photosynthesis Leaf Lab

CLASS COPY

Background:

Photosynthesis is the process by which light energy is harvested by chlorophyll and used to convert inorganic raw materials, carbon dioxide and water, into glucose and oxygen. Most of photosynthesis takes places in the green parts of plants and more specifically in the leaves. This is mainly due to a pigment found in a plant's leaves called chlorophyll. However, leaves often contain more than just that one, green pigment. The pigments in plants, other than chlorophyll, are collectively called accessory pigments, which assist chlorophyll in capturing light energy from the sun to make glucose. Usually, during most of the growing season, these accessory pigments aren't visible since the leaves are loaded with so much chlorophyll, which makes green the dominant, visible color. However, in the fall, when chlorophyll begins to break down, other colors, such as red, yellow, and orange, become visible.

Photosynthesis involves 2 stages - the light-dependent stage and the light-independent stage. In the light-dependent stage, water is split apart by sunlight into hydrogen, electrons, and oxygen. The hydrogen and electrons enters the second stage, oxygen is gaseous by-product. The equation for photosynthesis is as follows:

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

In the light-independent stage, energy in the form of ATP and NADPH is used by enzymes to catalyze the conversion of carbon dioxide into a carbohydrate, glucose. Glucose may be immediately used, joined to other monosaccharides to form disaccharides like fructose or sucrose, or stored as the polysaccharide starch. The light-independent stage of photosynthesis occurs in the stroma of the chloroplast.

It is advantageous to the plant to convert glucose to starch for storage. Starch is insoluble in water and therefore not a solute in the solution component of the stroma. Glucose on the other hand is soluble in water and if it accumulated in the stroma, the stroma would become more concentrated and hypertonic relative to the cell's cytoplasm. Water would move from the hypotonic cytoplasm via osmosis into the hypertonic stroma, causing chloroplasts to swell up and burst.

Testing a leaf for starch is the simplest photosynthesis lab. A positive test for starch in a leaf provides evidence that photosynthesis has occurred. The test for starch in a leaf requires a familiar indicator: Lugol's iodine.

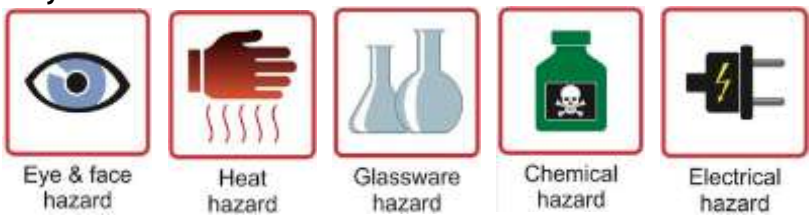
Objectives:

- ✓ to examine the importance of light to the process of photosynthesis
- ✓ to observe the range of pigments present in a leaf that assist in photosynthesis

Materials:

- live plant
- black construction paper
- light source
- 400 mL beaker (x2)
- tap water
- hot plate
- glass stir rod
- ethanol
- forceps
- weigh boat
- Lugol's iodine
- paper towels
- masking tape
- scissors
- timer
- hot water bath station (common area)

Safety:



Procedure:

DAY 1:

1. Select a leaf on a live plant.
2. Fold the construction paper so that it forms a shield to prevent light from reaching the leaf.
3. Cut out a portion of the construction paper to only allow a small area of the leaf to be exposed to the light.
4. Label the construction paper with your period and group number.
5. Secure the shield to the leaf using masking tape.
6. The plant will be placed under the grow light to be exposed to continuous light for 24 hours.

DAY 2:

7. ***CAREFULLY*** cut the leaf off the plant and remove the construction paper shield.
8. Fill a 400 mL beaker with 200-250 mL of tap water.
9. Place the beaker on the hot plate and turn it on to high. **DO NOT TOUCH, and monitor the water carefully as it heats to prevent any boil-overs.**
10. Once the water is boiling, drop the leaf into the boiling water.
11. If necessary, use the glass stir rod to ***GENTLY*** keep the leaf below the surface of the water. The leaf should boil for 2-3 minutes.
12. While the leaf is boiling, another group member should obtain about 75 mL of ethanol in the 400 mL beaker labeled ethanol. **Be sure to keep the beaker of ethanol a safe distance away from the hot plate.**
13. After the boiling time has elapsed, turn the hot plate to low so that the water stays hot *(but not boiling)*.
14. Use the forceps to remove the leaf from the water beaker, and place it directly into the ethanol beaker.
15. Bring your ethanol beaker to the hot water bath station. The ethanol beaker will sit in the hot water bath for 10-15 minutes.
16. After the hot water bath time has elapsed, retrieve your ethanol beaker with the leaf and ***CAREFULLY*** remove the leaf from the ethanol using the forceps. ★ ***NOTE: The leaf will likely be very brittle at this point. Handle it GENTLY so as not to damage it.***
17. Use the forceps to place the leaf in the water beaker again (the water should still be quite warm). Stir the leaf in the water beaker using the glass stir rod for at least 30 seconds. The leaf should become more flexible.
18. **TURN OFF** the hot plate and allow the water and beaker to cool.
19. Use the forceps to remove the leaf from the water beaker and place it onto a weigh boat. Blot the leaf dry with a paper towel.
20. Place a few drops of Lugol's iodine on the leaf and allow the iodine to soak into the leaf for a minute or two. You may need to use another paper towel to "force" the Lugol's iodine into the leaf by ***GENTLY*** blotting the leaf with a paper towel.
21. Observe the leaf for the presence of starch.
22. Record data.
23. Clean up the lab station according to the instructions.

CLEAN UP:

- ✓ chemical waste: ethanol
- ✓ sink: tap water
- ✓ rinse (no need to dry): beakers, glass stir rod, weigh boat
- ✓ trash: leaf, black construction paper, paper towels, masking tape
- ✓ everything returned to its original location