Starchy Surveillance!

- **OBJECTIVE**
  - The student will be able to explain where plants get their food from.
  - The student will be able to explain why light is important for plants
  - The student will be able to explain the importance of photosynthesis in plant growth.

- **PROBLEM / QUESTION**

  Where does a plant get its food?

- **PRIOR KNOWLEDGE**

  Photosynthesis (and respiration) is important parts of sustaining everyday life for both plants and animals alike. These processes are important in giving plants food (thus feeding herbivores and other animals as food webs progress).

- **BACKGROUND INFORMATION:**

  What do people need to grow? Why food of course. It is important for people and animals to eat a well-balanced diet to ensure that they get all of the nutrients they need to grow and move. Our primary source of energy is sugar, more specifically glucose. So where do plants get their food to grow and move? They need glucose too, but they cannot eat like we do. In today's experiment we are going to test plant leaves for the presence of starch, which is made from numerous glucose molecules linked together. Plants store excess sugar as starch so they can use it when they need it. This is much the same way that people store extra sugars as fat.

- **PREDICTIONS**

  In your science notebook, explain how the following things get their "food"/sugar from to grow bigger.
  - Acorn
  - Plant leaf
  - Tree trunk

- **SAFETY**

  You should wear safety googles at all times during this lab. Ethanol is flammable and shouldn't be used near an open flame (hot plate only). Do not eat or drink when using Ethanol and if it comes into contact with your skin, rinse well with water for several minutes. Iodine can stain clothing so use caution when dropping. When complete, the teacher may want to save the Ethanol for another class period, or it may be rinsed down the sink drain. The Coleus leaves should get placed in the trash, and petri dishes can get rinsed with water and dried to reuse. When handling KOH, use tweezers and avoid contact with your skin.

- **MATERIALS :**
  - Lab notebook
  - Provided pictures to categorize
  - Beaker
  - Hot plate
  - 95% Ethanol
  - Coleus plant kept in the light
  - Coleus plant kept in the dark
  - 2 petri dishes
  - Iodine Potassium Iodide (IKI)
  - pipette
  - KOH
  - Tweezers
  - Substance A
  - Substance B
  - Electronic Scale
  - Scoopula

- **PRELAB**

Starch verification:
Iodine turns color when exposed to starch. Place 0.5g of Substance A in a petri dish and 0.5g of Substance B in another beaker. Place 2-3 drops of iodine on each substance. Record your results in your lab notebook and be prepared to share your results with the class.

- **PROCEDURE**

BEFORE BEGINNING PART A, start a hot water bath. Place about 300mL of water in a 500mL beaker. Turn on the hot plate and bring water to a boil. You will use this later in the procedure.

PART A:

1. Using the provided pictures of plants, categorize the pictures based on how you think the plant gets its food to grow in size.
2. In your lab notebook, list your categories and the plant pictures that you placed in each.
3. Next to each category, give a brief explanation as to how you think plants in that category obtain food to grow.

PART B:

1. Obtain two Coleus leafs, one from the plant that has been kept in the *dark*, and the other from the plant that has been kept in the *light*. Be sure to choose leaves that are near the top of the plant as these are the ones that are growing, rather than the larger ones at the bottom.
2. Put a small tear at the top of the DARK leaf to ensure that you can tell the two leaves apart as the lab goes on.
3. In your lab notebook, trace both leaves, labeling them and color them as they appear.
4. Place leaves in boiling water (water should be at a rolling boil) for one minute. The leaves are placed in boiling water to remove the pink pigment (anthocyanin). After boiling the leaves, turn off the hot plate.
5. Next, using a beaker, bring Ethanol to a boil and place the leaves into the boiling water two minutes (teacher will have a station with boiling ethanol in a water bath to minimize ethanol fumes). Boiling the leaves in Ethanol removes the green pigment (Chlorophyll)

6. After the two minutes, remove the leaves and place them into a beaker of water for one minute to rehydrate them (this can be the same beaker of water you used to boil the leaves). At this time, the chlorophyll should be extracted from the leaf, and the color of the leaves is absent or lighter. The leaves will also be fragile at this time so use caution when handling them.
7. After the leaves have been in the water for one minute place each leaf into a separate petri dish and carefully flatten them out.
8. Next using a dropper, drop enough iodine solution on each leaf to cover it.
9. In order to see the color of the leaves more clearly after the iodine is added, hold the leaf gently in the petri dish and rinse the excess Iodine from the leaf with water.
10. Draw each leaf in your lab notebook and color each of them as they are seen.

- **DATA AND OBSERVATIONS**

  Be sure to record the following items in your lab notebook:
  - Drawings of leaves (with color) prior to experimentation
  - Drawings of leaves (with color) after iodine is added.
  - A clear and concise data table showing the results. A yes/no to the presence of starch will do.

- **RESULTS AND ANALYSIS:**

  In your lab notebook, answer the following in complete sentences:

  1. Which plant (if any) showed the presence of starch?
  2. What does the presence of starch mean?
  3. What does the absence of starch mean?
  4. Why would a plant have starch present?
  5. Why would a plant have a starch absence?

6. Based on your results, where do you think these plants get their food? Use your data to justify your answer.

<u>STOP HERE</u>: Please wait for a classroom discussion before completing the discussion and homework questions.

- **DISCUSSION:**

  In your lab notebook, answer the following**:**

  1. When categorizing the pictures of the plants, what did you find difficult in categorizing these plants?
  2. It is likely when you categorized the pictures in Part A, you noted the differences in the plants, but what thing did all of the pictures have in common?
  3. Look back at your explanations of where you thought an acorn, leaf, or tree trunk got its food. Were your explanations correct? Why or why not?
  4. What is the driving force required for plants to produce food for growth? What evidence from your experiment supports this?
  5. Write a paragraph explaining where an acorn, leaf, or tree trunk obtains its matter.
  6. Mrs. Meyer had had a garden to grow herbs, tomatoes, and various vegetables for years. Last spring I planted a Flowering Dogwood tree near the garden, and it puts shade over the part of the garden that has the tomatoes in it. I harvested everything at normal times last year, except for the tomatoes which ripened almost a month later than normal. What could be the reason for the delay in the production of tomatoes?

- **GOING FURTHER:**
  PART C:

  Question: Where does the plant get Carbon Dioxide and water from for photosynthesis?

  1. In your lab notebook, make a prediction as to where you think a plant gets Carbon Dioxide from to undergo photosynthesis. What about water?
  2. Pick one of the following: (draw a picture your lab set up in your lab notebook)
     - Smear Vaseline on the bottom sides of the leaves and place plant in bell jar/bottle overnight leaving by the window so the plant can obtain sunlight.
     - Place plant in a closed system (bell jar or bottle) and inside the closed system also use a tweezers to add a pellet of KOH to the system which will remove the Carbon Dioxide. Leave the system by the window until class tomorrow.
  3. After your plants have been sitting for 24 hours, select one leaf from your plant and draw a picture of it in your lab notebook.
  4. Using the same procedure as before, remove the pigment from the plant with Ethanol, hydrate the leaf, and then stain with Iodine testing for the presence of Starch. Remember to draw a picture of your leaf after testing with Iodine.
  5. In your lab notebook complete the following and be prepared to discuss your answers as a class.

     - Write a statement indicating what happened, why it might have happened, and give evidence for your reasoning.

     - Using what you know and the parts of this lab, write an equation for photosynthesis. Be sure to balance the equation once you have the correct products and reactants.

- **GOING FURTHER: (homework assignment)**

Please read the following about a famous science experiment, and answer the questions in your lab notebook.

Jean Baptista van Helmont (1577-1644) performed a classic experiment on photosynthesis. In paragraph below, van Helmont describes his experiment. Read the paragraph and then address the questions that follow.

I took an earthen pot and in it placed 200 pounds of earth which had been dried out in an oven. This I moistened with rain water, and in it planted a shoot of willow which weighed five pounds. When five years had passed the tree which grew from it weighed 169 pounds and about three ounces. The earthen pot was wetted whenever it was necessary with rain or distilled water only. It was very large, and was sunk in the ground, and had a tin plated iron lid with many holes punched in it, which covered the edge of the pot to keep air-borne dust from mixing with the earth. I did not keep track of the weight of the leaves which fell in each of the four autumns. Finally, I dried out the earth in the pot once more, and found the same 200 pounds, less about 2 ounces.

1. Write down the weights (in your lab notebook) that van Helmont measured:
    - Initial weight of soil =
    - Initial weight of plant =
    - Final weight of soil =
    - Final weight of plant =
    - Change in weight of plant =

2. What question was van Helmont trying to answer?
3. Based on the information given, what is the conclusion from van Halmont's Willow experiment?
4. In van Helmont's experiment, light energy was necessary for the willow to gain mass. What happened to the light energy after it reached the willow plant? Write down the specific equation for photosynthesis and relate the equation to this question.
5. Where did the new mass in the plant come from?
6. The Law of Conservation of energy states that energy can never be created or destroyed. Plants takes light energy from the sun and uses it to produce sugar through the process of photosynthesis. Describe the specific of energy conversions that occur during this process.

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