

## “PHOTOSYNTHESIZE ME - WATER, PLEASE”

### OBJECTIVE:

Students will understand the difference between photosynthesis and respiration. Students will learn that when these two processes entail and how plant and animal kingdoms are connected. Students will learn the crucial importance of sunlight, carbon dioxide, and water in both processes.

### PURPOSE:

Educate students on the importance of sunlight, carbon dioxide, and water in the circle of life for both plants and animals through the processes of Photosynthesis and Respiration.

VOCABULARY: “Photosynthesis”, “Respiration”, “Glucose”, “CO<sub>2</sub>”, “Carbon Dioxide”, “O<sub>2</sub>”, “Oxygen”, “H<sub>2</sub>O”, “Water”, “C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>”, “Stomata”, “Thylakoids”, “Photons”, “Epidermis”, “Carbohydrate”, “Transpiration” and “Chloroplast”.

### TIME NEEDED:

1. 5 hours (30-45 minute class prep and Introduction; 45 minute lab)

### TEACHER PREP AND BACKGROUND RESEARCH:

View the following video on YOUTUBE:

<https://www.youtube.com/watch?v=uYksRZebxic>

Mosa Mack Science Photosynthesis (7:11 min)

### CLASS PREP AND INTRODUCTION:

1. In a class setting or in small groups, have students view the animation at the following YouTube link:

<https://www.youtube.com/watch?v=uYksRZebxic>

Mosa Mack Science Photosynthesis (7:11 min)

2. Ask students what they think is the missing element in the health of the fern in this video?

3. Have students write their answers on a sticky note and post on a central spot in the classroom where Teacher can read off to class and discuss comments. (Allow time for students to ask questions, and to discuss possible misconceptions without correcting.)

4. Read the Introduction section below together as a class and pay particular attention to the vocab terms

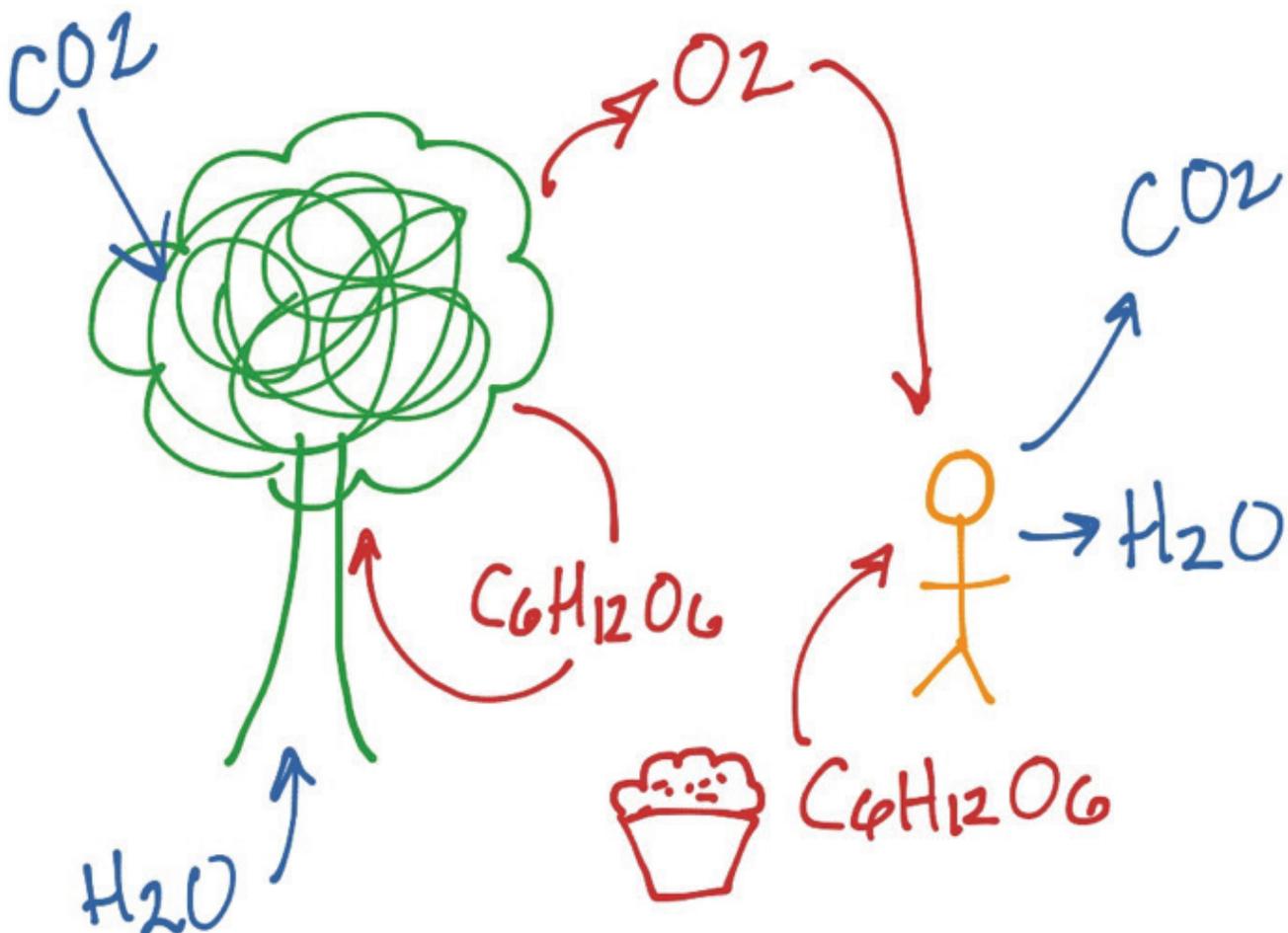
"Photosynthesis", "Respiration", "Glucose", "CO<sub>2</sub>", "Carbon Dioxide", "O<sub>2</sub>", "Oxygen", "H<sub>2</sub>O", "Water", "C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>", "Stomata", "Thylakoids", "Photons", "Epidermis", "Carbohydrate", "Transpiration" and "Chloroplast".

5. Now have students view the following video clip:

"Photosynthesis and Respiration | Chemistry for All | The Fuse School" (6 min)

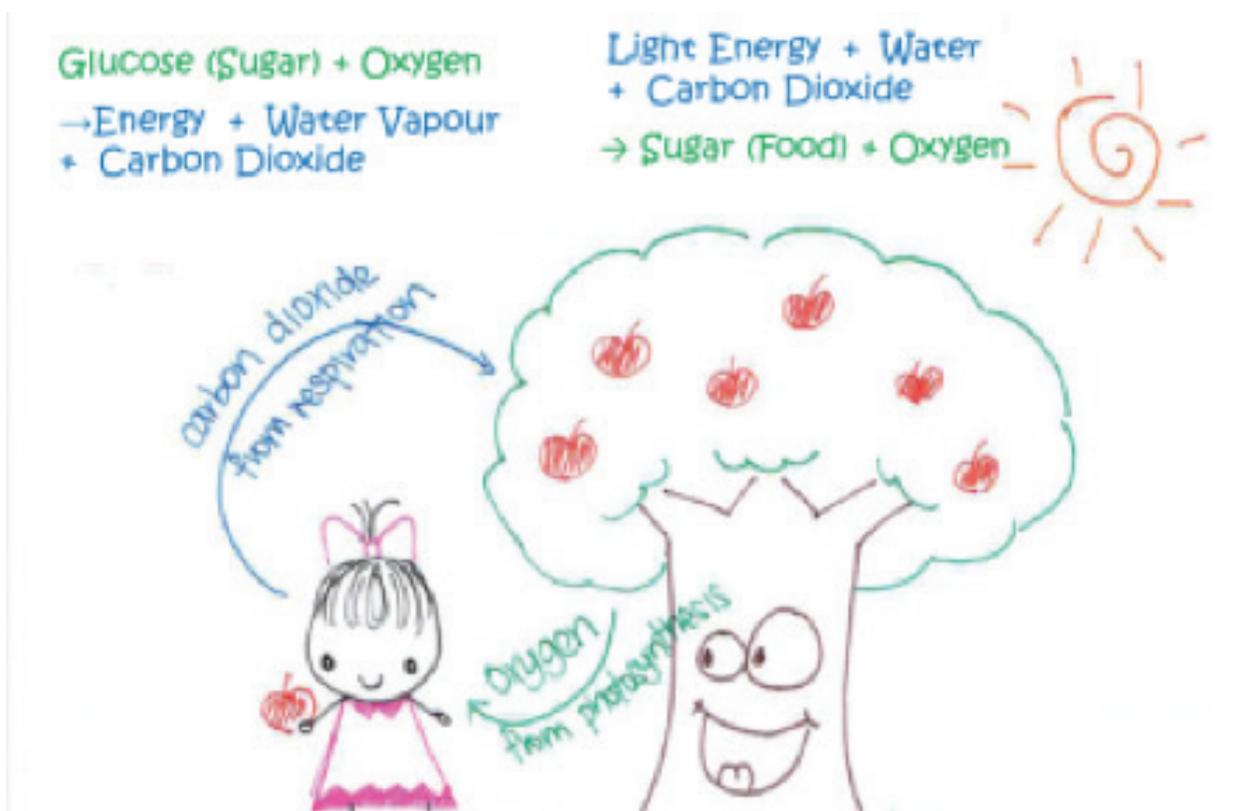
<https://www.youtube.com/watch?v=3XlyweZg6Sw>

6. Now pass out large Construction paper, one to each student. Instruct them to fold it in half like a large book. This will become a Giant Foldable. Have students label the top of the Front Cover "PHOTOSYNTHESIS", leaving room for a drawing of a tree in the middle of the page. On the bottom of the Front Cover, have students write the words, "A Plant Needs...". At this time, have students draw a picture of a tree in the middle of the page and ask them what 3 ingredients do plants need to do photosynthesis? Write them down, using both their chemical formulas as well as their common names, labeling and drawing each as you go. (See diagram example below. Break up the left side from the right side, saving the stick figure drawing of the human for the Inside and the Back Page drawings. Don't forget sunlight! It's what Mosa Mack discovered was the missing link in the health of the fern from the video viewed earlier.)



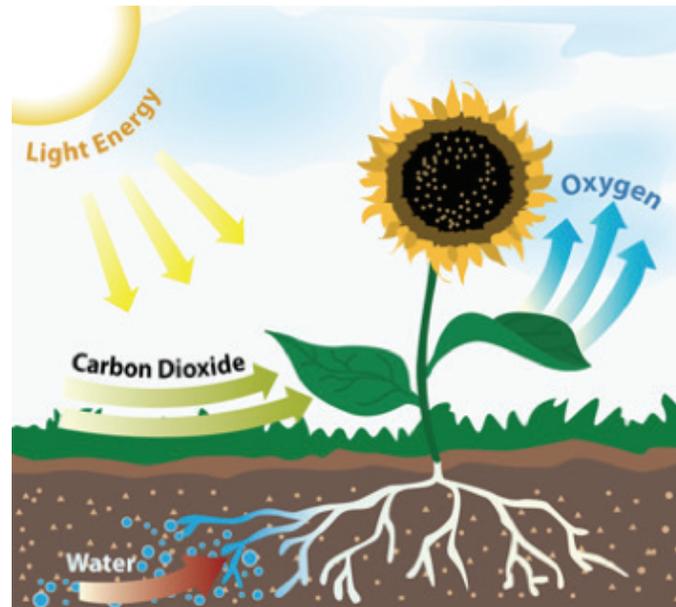
7. Open the Giant Foldable to the Inside Cover. Have students label the top of the Inside Cover "PHOTOSYNTHESIS" again, leaving room for a drawing of a tree in the middle of the page. On the bottom of the Inside Cover, have students write the words, "A Plant Produces..." Now have students draw a picture of the same tree from the Front Cover and have students complete the statement. There should be 2 products that a plant produces. Draw and label them here, and try to use their chemical formulas. (see diagram above and below.)

8. On the Facing Page to the Inside Cover, now have students write the title, "RESPIRATION", leaving room in the middle of the page for a stickman drawing of a human. Have students write on the bottom of the page, "An Animal Needs..." Like the diagram above, have students now draw a stick figure of a human, and label the 2 requirements an animal would need to survive that a plant produces. (See diagram below. An apple held in the child's hand could represent Glucose.)



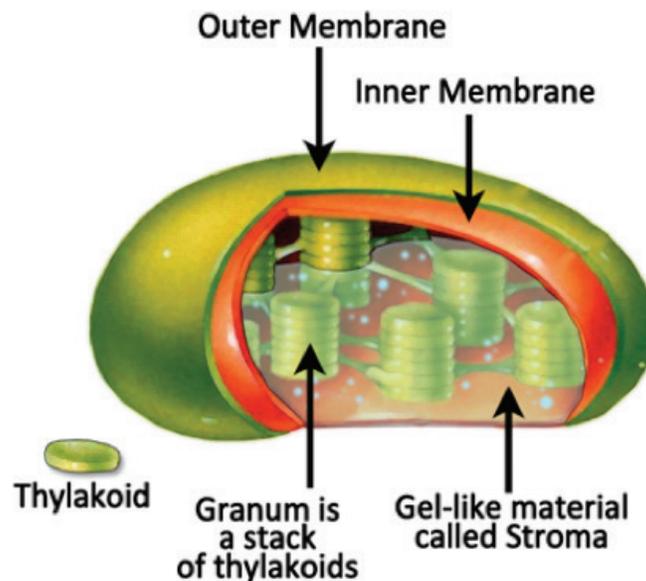
9. On the Back Page, have students write the title, "RESPIRATION", again, leaving room in the middle of the page for a drawing of a stickman human. Have students write the words on the bottom of the page, "An Animal Produces...". Finally, have students complete the last page with a drawing of a stick figure and complete the statement. Be appropriate. Students can represent "water waste" with sweat, and energy lost as "heat", since most animals are warm-blooded. Breathing out CO<sub>2</sub> should be easy to draw as well.

## INTRODUCTION:

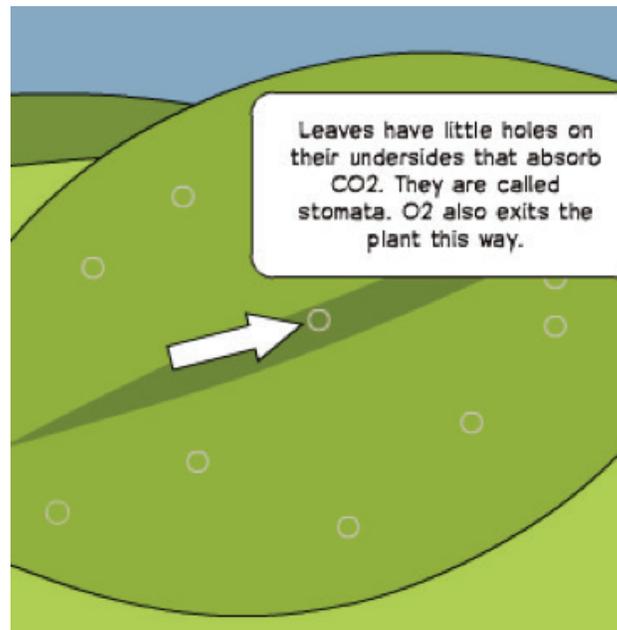


Photosynthesis begins in plants when sunlight strikes the tops of leaves and are absorbed by organelles known as chloroplasts. Within the chloroplasts are tiny structures that resemble mini stacks of thin pancakes, called thylakoids. Thylakoids face the top layer of the leaf, known as the epidermis and their main job is to capture photons of light and store them much as a battery would.

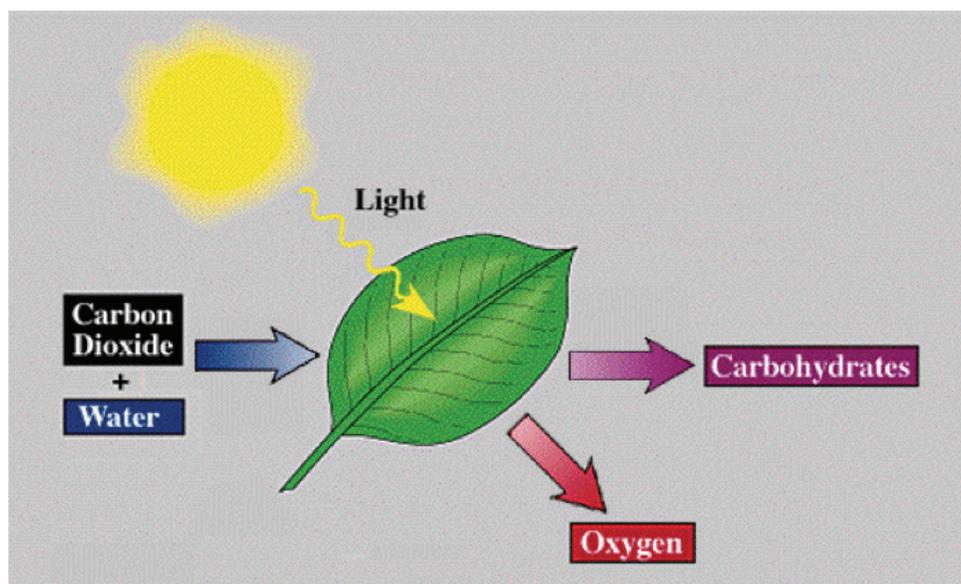
## Inside a Chloroplast



Water is then obtained through the roots of a plant and Carbon Dioxide enters through stomata's, or holes, located on the underside of leaves.

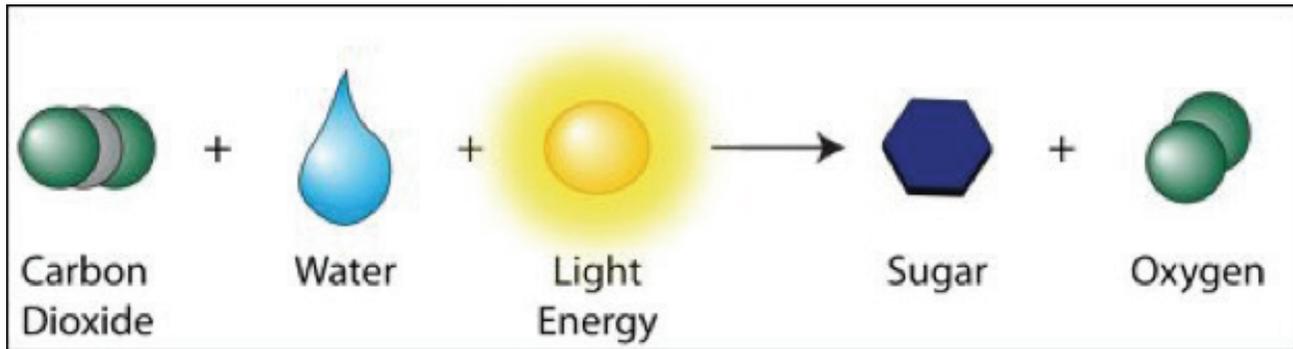


This energy is then used to break the bonds holding water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>) into a waste product known as Oxygen (O<sub>2</sub>).

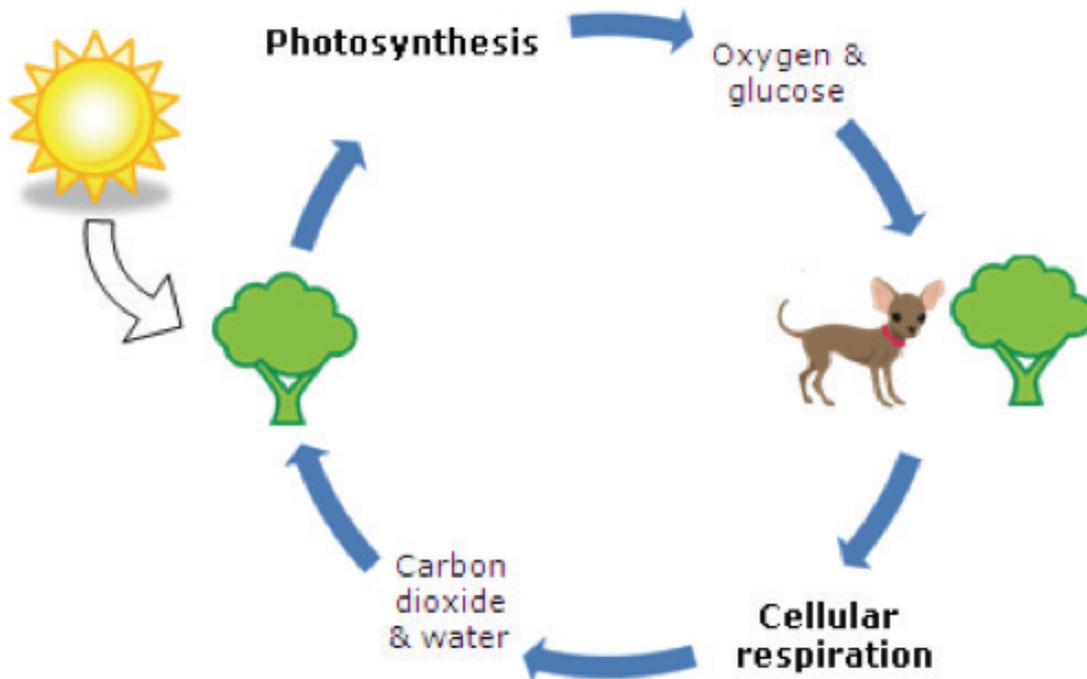


The remaining carbons and hydrogens combine with some of the oxygen to produce a carbohydrate known as glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).

This sugar is stored as energy in the leaves, fruits and vegetables of a plant.



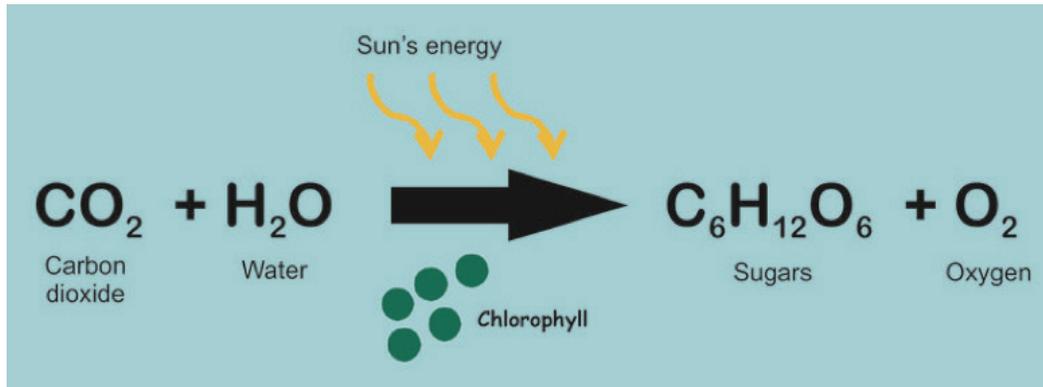
When an animal eats leaves, fruits or vegetables from plants, this glucose is broken down within the cells, which releases energy for the organism. Oh, and that waste product from plants, called oxygen? Animals couldn't live without it! So you see, it is a "circle of life"?



Even humans couldn't survive without the world of plants for our food and our oxygen. The same goes for plants. Animals make carbon dioxide as a waste product that is released from cells and plants cannot do photosynthesis without it.

**LAB:**

**NAME:** \_\_\_\_\_ **DATE:** \_\_\_\_\_ **PERIOD:** \_\_\_\_\_



**MATERIALS:**

(per group or as class demo): 3 small plants of the same species, each with at least 5 leaves; 3 mason jars large enough to fit over each plant, with lids; clear packing tape, black sharpie; masking tape; 15 mL of water; sunny windowsill.

**HYPOTHESIS:**

If we cover the bottom side of all the leaves of a plant with clear packing tape and place it under a mason jar in a sunny location for 5-10 days, and cover the tops of the leaves with masking tape of another plant and place it under a mason jar in a sunny location for 5-10 days, then we predict that the plant with tape on the \_\_\_\_\_ (top or bottom part of the leaves) will grow higher. If we place a third plant under a mason jar and leave all leaves alone, then we predict that it will grow the \_\_\_\_\_ (most or least, compared to the other two plants).

(circle one answer per blank above)



**HYPOTHESIS:**

1. Divide students into groups of 3 or 4.
2. Have students obtain 3 mason jars and 3 plants of the same species, preferably with larger leaves (at least 5 on each plant). Make sure to water each plant the exact same amount (about 5 mL each) before beginning experiment.
3. Next, have students place one plant under a mason jar and seal the bottom lid (if this isn't possible, it is acceptable to place them plants and jars in a location which will not be disturbed for the duration of the experiment. The lid is just to avoid spills.) Label this plant "CONTROL", on the outside of the jar using masking tape and the sharpie. Place on a sunny windowsill to be undisturbed for the next 5-10 days.
- 4 Next, have students choose a second plant and have them cover the bottom of at least 5 leaves with clear packing tape. (It is ok if some of the tape must wrap around to the top of the leaf in order to stay on.) Have students place this plant carefully under a second mason jar and seal with the lid. Label this plant on the outside of the jar "CLOSED STOMATAS", and place it next to the CONTROL on the sunny windowsill.
5. Finally, have students take the third plant and using the masking tape, cover at least 5 leaves on the topsides of the leaf, making sure not to wrap the tape under the leaf. This may interfere with the final results. Have students place this plant under the third mason jar and seal with the lid, labeling on the outside of the jar "THYLAKOIDS BLOCKED". Place the third jar next to the other two on a sunny windowsill. Leave for 5-10 days undisturbed.
6. For the next 5-10 days, have students write down observations about each plant, remarking on number of leaves, and color or state of the plant, as well as measuring the height in cm of the plant from the outside of the jar, without disturbing or moving the plants inside the jars. Record on the Data Tables below.

PLANT #1 - CONTROL	HEIGHT (CM)	COLOR (SEE WHEEL)	NOTES:
DAY 1			
DAY 2			
DAY 3			
DAY 4			
DAY 5			
DAY 6			
DAY 7			
DAY 8			
DAY 9			
DAY 10			
AVERAGES			



<b>PLANT #2 – CLOSED STOMATAS</b>	<b>HEIGHT (CM)</b>	<b>COLOR (SEE WHEEL)</b>	<b>NOTES:</b>
<b>DAY 1</b>			
<b>DAY 2</b>			
<b>DAY 3</b>			
<b>DAY 4</b>			
<b>DAY 5</b>			
<b>DAY 6</b>			
<b>DAY 7</b>			
<b>DAY 8</b>			
<b>DAY 9</b>			
<b>DAY 10</b>			
<b>AVERAGES</b>			

<b>PLANT #3 – THYLAKOIDS BLOCKED</b>	<b>HEIGHT (CM)</b>	<b>COLOR (SEE WHEEL)</b>	<b>NOTES:</b>
<b>DAY 1</b>			
<b>DAY 2</b>			
<b>DAY 3</b>			
<b>DAY 4</b>			
<b>DAY 5</b>			
<b>DAY 6</b>			
<b>DAY 7</b>			
<b>DAY 8</b>			
<b>DAY 9</b>			
<b>DAY 10</b>			
<b>AVERAGES</b>			

**INTERPRETING DATA:**

CONTROL:

- 1) What did you notice most about the Control plant?
- 2) Why do you think this plant grew the way it did? Did it grow higher than the other two, stay the same, or grow the least? (Was your Hypothesis proven correct or incorrect?) Why do you think this is?

CLOSED STOMATAS:

- 3) What role do the stomata's play in the process of photosynthesis?
- 4) What did you notice most about the plant with Closed Stomata's?
- 5) Why do you think this plant grew the way it did? Did it grow higher than the other two, stay the same, or grow the least? (Was your Hypothesis proven correct or incorrect?) Why do you think this is?

THYLAKOIDS BLOCKED:

- 6) What role do the thylakoids play in the process of photosynthesis?
- 7) What did you notice most about the plant with Thylakoids Blocked?
- 8) Why do you think this plant grew the way it did? Did it grow higher than the other two, stay the same, or grow the least? (Was your Hypothesis proven correct or incorrect?) Why do you think this is?

ANALYSIS:

- 9) What role does sunlight play in the process of photosynthesis? Were the plants in this experiment able to receive sunlight? If not, which ones were blocked from receiving sun?
- 10) What role does Carbon Dioxide play in the process of photosynthesis? Were the plants in this experiment able to receive carbon dioxide? If not, which ones were blocked from receiving CO<sub>2</sub>?

BONUS QUESTIONS:

- 11) What role does Oxygen play in the process of photosynthesis? Were the plants in this experiment able to release oxygen? If not, which plants were blocked from releasing O<sub>2</sub>?
- 12) What importance does water play in the process of photosynthesis? (Believe it or not, some water does exit through the stomata of leaves, in a process known as "Transpiration". Ever touch a leaf and your fingers felt a little wet afterwards? That's not rain you just touched. It's kind of like the plant is sweating and it's a by-product of photosynthesis, albeit a small one.)
- 13) What would be a future experiment that you could do with this plant to test what role water plays in the process of photosynthesis? (HINT: Where does the plant get the water necessary to conduct photosynthesis, and start your experiment from there.)



**SUMMARY CONCLUSION:**

Please write a 3-5-sentence paragraph using at least 5 of the words from the word bank below. Try to describe what happened during this lab according to your data and what you learned from your data.

**WORD BANK:**

Photosynthesis, Respiration, Glucose, CO<sub>2</sub>, Carbon Dioxide, O<sub>2</sub>, Oxygen, H<sub>2</sub>O, Water, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, Stomata, Thylakoids, Photons., Epidermis, Carbohydrate, Transpiration and Chloroplast.

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