Name: _____ Date: _____

Sunny Synthesis

Data Sheet

Question: Do plants take in and release gas?

Materials: straws, bromthymol blue, labels, spring water, white paper, *Elodea* sprigs, vials with lids, safety goggles

Procedure A:

1. Label two vials "In Dark" and two vials "In Light". Write the name of the Material Manager on the labels so he/she can locate them after the test.
2. Put on safety goggles. This activity uses a chemical indicator called bromthymol blue.
3. Fill the vials ¾s full of water and add 15 drops of bromthymol blue. Place a white sheet of paper behind each vial, observe, and record the color of the solution below.
4. Bubble into the solution slowly and carefully, so splashing and spilling do not occur. **Exhale** only while bubbling and take the straw away from your mouth if you need to take a breath.
5. Place a white sheet of paper behind each vial, observe, and record the color of the solution below.
6. Place a sprig of Elodea in an "In Dark" vial and an "In Light" vial.
7. The other "In Dark" and "In Light" vials will serve as controls so they will only contain water and bromthymol blue.

Uptake of Carbon Dioxide by *Elodea*			
Light conditions and contents of vial	**Color of solution when bromthymol blue indicator is added**	**Color of solution when carbon dioxide is added by bubbling**	**Color of solution after waiting one or two days**
"In Dark" - water and bromthymol blue			
"In Dark" - Elodea, water, & bromthymol blue			
"In Light" - water and bromthymol blue			
"In Light" – Elodea, water & bromthymol blue			

Based on your observations of the vials, summarize ALL changes that occurred and their causes.

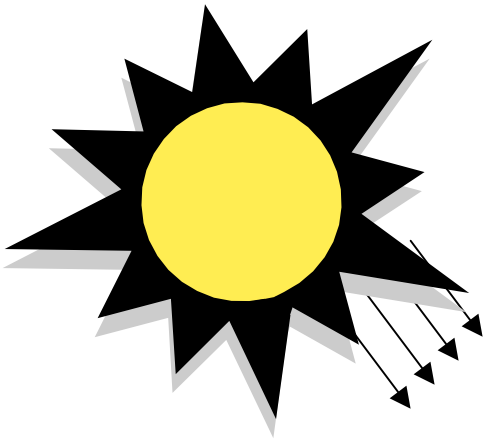
Procedure B.

Materials: spring water, *Elodea* sprigs, test tubes, large beaker, clear funnel, light, pin

1. Snip off the ends of two Elodea sprigs, and use a pin to poke two holes in the end of the stem. Push the cut ends up into the pointed area of the funnel. Prepare two funnels.
2. Fill two beakers $\frac{3}{4}$ full of spring water. Immerse a funnel in each beaker, with the pointed end sticking up.
3. Fill two test tubes with spring water. Keeping your finger over the ends to prevent the water from running out, turn each test tube upside down over a prepared funnel.
4. Place one beaker under a light source, and the other in dark. Wait at least 45 minutes before making observations.
5. Draw a labeled diagram in the box below to record your observations of both beakers and any changes that occur.

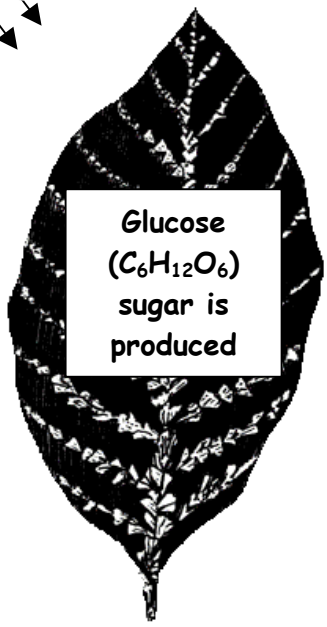
Light	Dark

Photosynthesis



Sunlight energy is absorbed by chlorophyll in the leaf

Carbon dioxide (CO_2) gas **enters** the leaf



Oxygen (O_2) gas **exits** the leaf

Water (H_2O) travels from roots to leaves in xylem tubes

$$\text{Water} + \text{Carbon dioxide} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{Glucose} + \text{Oxygen}$$

$$(H_2O) \quad (CO_2) \qquad (C_6H_{12}O_6) \quad (O_2)$$

Name: _____ Date: _____

Photosynthesis Performance Task

Design an experiment that will test the effects of changing either the amount of light or the amount of carbon dioxide during plant photosynthesis. Working with your group, discuss and plan the experiment on the Photosynthesis Investigation Planning Guide before beginning the experiment. Deciding how you will measure the effect of the light or carbon dioxide on photosynthesis is an important topic to decide upon before planning the experiment. The procedure must be approved and initialed by the teacher before you begin testing. **Be sure to include any safety measures that must be followed.**

You will be provided with the following materials to choose from:

Elodea sprigs
Glassware (beakers, funnels, test tubes, flasks, petri dishes)
Light sources with 75 or 100-watt bulbs
Grow lights, if available
Baking soda

Helpful Hints !

*Remember that the release of oxygen gas bubbles formed during photosynthesis can be observed when broken *Elodea* sprigs are placed in a test tube of water. An increase in the number of released oxygen bubbles indicates an increase in the rate of photosynthesis.

* Adding a pinch of baking soda ($NaHCO_3$) to the water in a test tube increases the carbon dioxide in the Elodea's water. Therefore, bubbling into the tube is not needed.

Name: _____ Date: _____

Investigation Planning Guide

PROBLEM (Ask a clear question that can be tested.)

HYPOTHESIS (Make a prediction about what may be the answer to the question.)

MATERIALS (List the materials needed to perform the experiment.)

PROCEDURES (State exactly what must be done during the experiment in step-by-step order. Begin each step with a verb and end each step with a period. Avoid using " I" or "you" in the steps. Repeat trials whenever possible.)

RESULTS (The observations of what happened during the experiment should be recorded in words, pictures, charts, or graphs.)

CONCLUSION (A statement that interprets the results of the experiment and states whether or not the hypothesis was supported.)

Name: _____ Date: _____

Photosynthesis Scoring Rubric

A. Experimental Design	The problem is clear and testable. A valid, practical procedure is presented in a logical sequence to allow gathering of accurate data suitable for analysis to accomplish the task.	4
	The problem is clear and testable. Valid, practical procedure is presented that contains errors or omissions that may hinder the gathering of accurate data suitable for analysis to accomplish the task.	3
	The problem is testable. A practical procedure with many steps insufficiently described or missing prevents the gathering of accurate data for the task.	2
	The problem is partially testable. The procedure is highly incomplete, and the method used to gather data is inappropriate for the task.	1
	The problem is not testable. The procedure is missing, or cannot generate useful data.	0
B. Data collection	The collected data and observations are complete, clearly and logically recorded, and consistent with the procedure. Measurements are precise. Technology used to develop a clear and attractive display of data in charts and graphs.	4
	The collected data and observations are fairly complete, clearly recorded, and fairly consistent with the procedure. Data is clearly displayed in chart or graph form.	3
	The collected data and observations have several omissions, recorded in a way that is difficult to interpret, and relate somewhat to the procedure. Data display is unclear.	2
	The data gathered is very incomplete, and is not related to the procedure. No charts or graphs of the data are included.	1
	No data or observations are recorded	0

C. Evaluation of Data and Conclusion	Clear communication of complete and accurate analysis of data and observations. Accurate conclusion is reached, which is supported by the analysis.	4
	Communication of complete but slightly flawed analysis of data and observations, which leads to a slightly inaccurate conclusion.	3
	Unclear communication of accurate conclusion with no analysis, or the analysis does not support the conclusion.	2
	Unclear communication of inaccurate conclusion with no analysis.	1
	No conclusion or analysis is present.	0
D. Lab Skills, Safety, and Participation	Selects and uses appropriate equipment with care and proficiency. Listens attentively, and stays actively involved in an organized approach.	4
	Uncertain about equipment selection, but uses equipment carefully. Listens to instructions and stays involved, but may wait for others to lead.	3
	Is not familiar with use of equipment, so chooses inappropriate equipment, but does not abuse equipment. Distracted during instructions, so must rely on others for directions.	2
	Uses equipment improperly, and is haphazard and disorganized. Is distracted during instructions, and needs constant reminders to stay on task	1
	Does not use equipment or abuses equipment. Is disruptive during instructions and activity.	0
	Total points	

Name: _____ Date: _____

Sunny Synthesis Assessment

TASK 1

Materials: 1 bag of photosynthesis cards

1. Remove the cards from the bag and determine which cards should be used to illustrate the process of photosynthesis. (Place any cards that are not needed back into the bag.)
2. Sequence the cards to show the substances needed for photosynthesis on the left side of the arrow and the substances produced by photosynthesis on the right side of the arrow.

Record the sequence of the cards in the blanks below.

_____

_____ + _____ → _____ + _____

_____

TASK 2.

Draw a diagram of a plant leaf below. Show the substances that must be present to begin photosynthesis on the left side of the leaf and the substances that are produced by photosynthesis on the right side of the leaf. Include any energy sources that are needed.

Sequencing Photosynthesis Cards

carbon dioxide	oxygen
sunlight	glucose sugar
chlorophyll	water
bromthymol blue	Lugol's iodine
Elodea	

Name: _____ Date: _____

Sunny Synthesis

Scoring Rubric

Task	Criteria	Pts.
Task 1 Selects correct photosynthesis cards and sequences on appropriate sides of the arrow	Correct materials needed and materials produced on appropriate sides of the arrow, no omissions	4
	Omitted or misplaced one card	3
	Omitted or misplaced two cards	2
	Omitted or misplaced three cards	1
	Omitted or misplaced four cards	0
Task 2 Draws and labels leaf diagram, showing the correct materials needed and materials produced in photosynthesis	Detailed, labeled drawing, no omissions	4
	Fairly detailed drawing, 1 omission	3
	Fairly detailed drawing, 2 omissions	2
	Few details in drawing, 3 omissions	1
	No drawing	0
	POINTS	

Station A. Do plants use carbon dioxide gas in light?

1. Observe the bromthymol blue solution in the vial located on the left side of the station. Record observations on the data chart in the first column. All of the "In Dark" and "In Light" vials contain this solution.
2. Observe the four vials in the middle of the station that were prepared this morning. Carbon dioxide was bubbled into the bromthymol blue solutions of all of the "In Dark" and "In Light" vials. An *Elodea* plant was added to one "In Dark" and one "In Light" vial. Record your observations in the second column of the data chart.
3. Observe the four vials on the right side of the station that were prepared two days ago in exactly the same manner as above. Record your observations in the last column of the data chart.
4. Summarize all of the changes that occurred and inferences about their causes on the data sheet.

"IN DARK"	"IN LIGHT"

PREPARED THIS **MORNING**	**PREPARED 2 DAYS AGO**

Station B. Do plants release oxygen gas in light?

1. Observe the set of beakers, *Elodea* plants, and funnels located on the left side of the station. These were prepared this morning using the Procedure B. directions listed on the student data sheet.
2. Observe the set of beakers, *Elodea* plants, and funnels located on the right side of the station. These were prepared 24 hours ago using the Procedure B. directions listed on the student data sheet.
3. Compare the beakers on the left and right sides of the station. Can you observe any changes that occurred during the 24-hour period?
4. Draw a labeled diagram in the Light and Dark boxes on the data sheet to record your observations of the beakers that were prepared 24 hours ago. Be sure to note any changes in the beakers.

PREPARED THIS MORNING	**PREPARED 24 HOURS AGO**

Station C. How do plants capture light energy for photosynthesis?

1. Observe the Elodea slides /pictures. Do you see oval cell parts that might contain a green pigment called chlorophyll that captures sunlight energy for photosynthesis?
2. Draw these green cell parts, called chloroplasts, in your journal.

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Station D. Can plants make food if they are deprived of light?

1. Observe the potato slices in the closed petri dishes located on the left side of the station. The one labeled "With Iodine" had drops of iodine placed on top. What color is the top of the potato where drops of iodine touched it? (Iodine is an indicator that changes to a blue-black color when in contact with starches.) Record your observations in your journal. Is potato a starch?
2. Observe the leaf in the closed petri dish located on the right side of the station. Foil was used to shield half of the leaf from light for four days. Then, the leaf's chlorophyll was removed with alcohol so it would not interfere with test for glucose stored as starch.
3. Does the leaf give any evidence of glucose stored as starch?
4. Are both sides of the leaf the same color after iodine is added?

"With Iodine"	"Without Iodine"	"With Iodine"

Station E. How do plants get the water needed for photosynthesis?

1. Observe the stalk of celery in plain water located on the left side of the station. Observe the thin slices of this celery in the petri dish with a hand lens. Record observations and drawings of the tiny bundles of "tubes" that are visible in the slices.
2. Observe the stalk and slices of celery that have soaked overnight in a solution of red food coloring. Record observations in your journal, noting any differences in the "tubes."

With Food Coloring	**Without Food Coloring**

Station F. How do gases needed for photosynthesis get to leaves?

1. Observe the stomata slides/pictures taken with a camera and a microscope. What do the stomata remind you of?
2. What gas must enter the leaf?
3. What gas must exit the leaf?