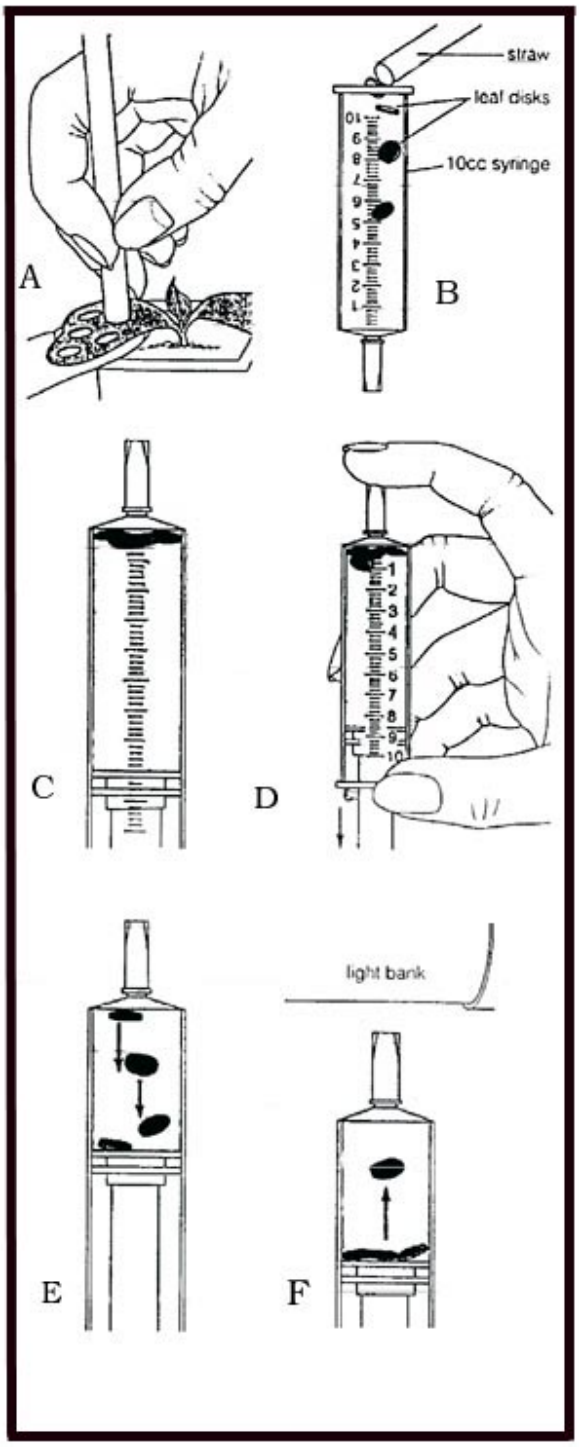
CLASSROOM COPY- Dry Lab

Photosynthesis: Measuring Photosynthetic Rate in Spinach Leaf Disks

Photosynthesis is a process in which primary producers are able to convert light energy (sunlight) into usable chemical energy (carbohydrates). Photosynthesis involves two interlinked processes: the light dependent reaction and the light independent reaction. In the light dependent reaction, light energy is captured and converted to high energy ATP and NADPH molecules. In the light independent reaction these high-energy molecules are used to reduce CO_2 to carbohydrates like glucose.

Overall reaction:
$CO_2 + H_2O$ + light energy → Glucose + O_2



In this experiment, the intercellular spaces of spinach leaf disks are infiltrated with a sodium bicarbonate solution, which causes them to sink in the solution. As photosynthesis occurs, oxygen is produced and collects in the intercellular spaces causing leaf disks to re-float.

Dry Lab

In the following data tables, we have provided two experiments: One, where we test photosynthesis in the presence or absence of carbon dioxide. Second, where we test photosynthesis based on different colored lights.

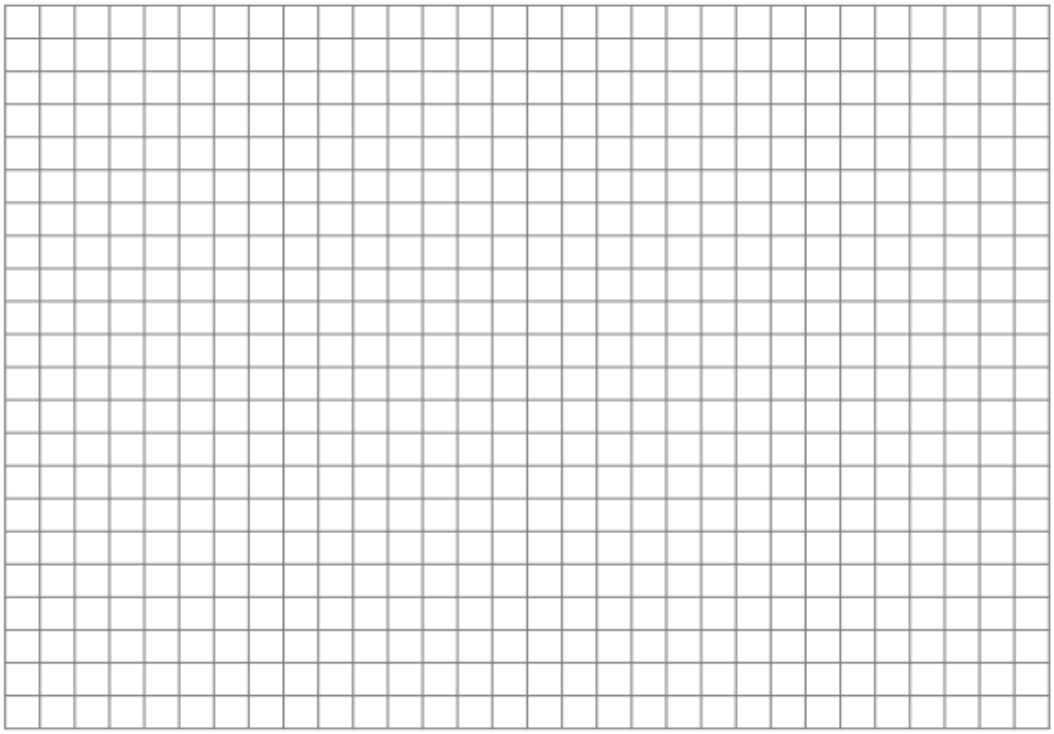
Data: Number of Spinach Disks Floating

Time Elapsed	Number of Dots Risen	
Carbon Dioxide or Not	With Carbon Dioxide (CO_2)	Without Carbon Dioxide (CO_2)
0	1	0
1	1	0
2	1	0
3	2	0
4	6	0
5	6	0
6	7	0
7	8	0
8	9	0
9	9	0
10	10	0

Using the graph below graph the results from all treatments.

a. What is the independent variable? _____

b. What is the dependent variable? _____



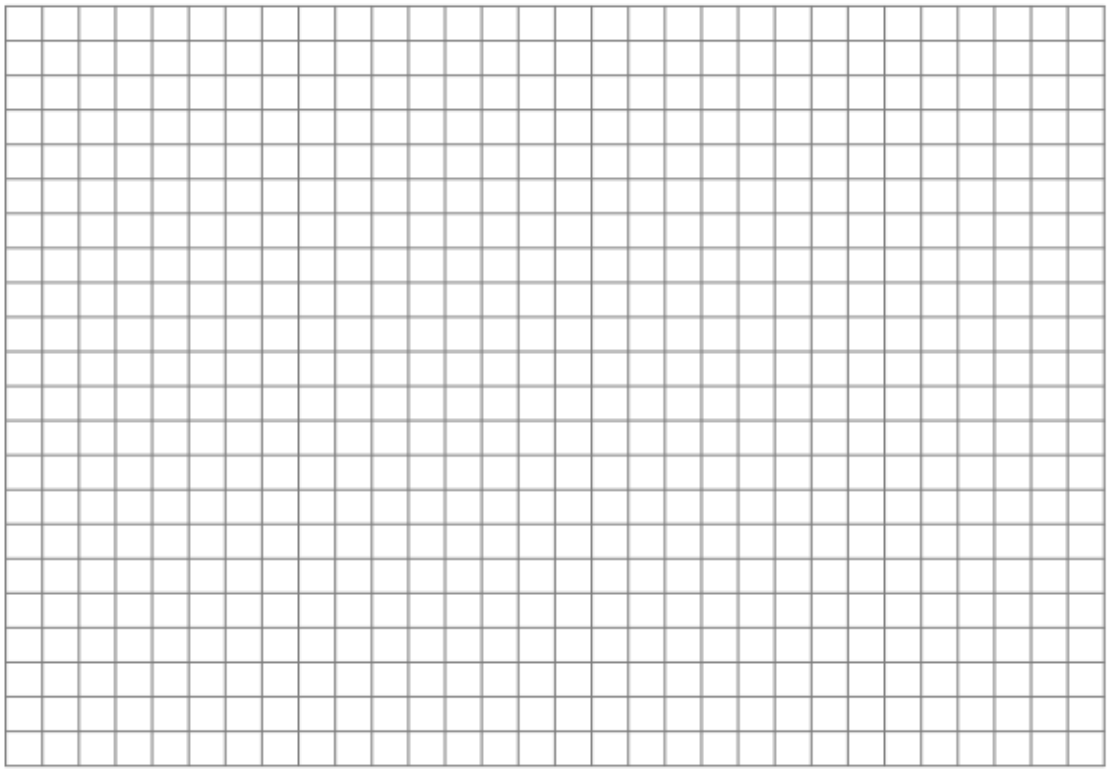
Data Table: Number of Spinach Disks Floating

Time Elapsed	Number of Dots Risen		
Cellophane Cover Color	Clear	Red	Green
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	1	0	0
8	2	0	0
9	4	0	0
10	5	0	0
11	6	0	0
12	6	0	0
13	6	0	0
14	7	2	0
15	9	5	0
16	10	7	0
17	10	8	0
18	10	9	0
19	10	9	0
20	10	10	0

Using the graph below graph the results from all treatments.

a. What is the independent variable? _____

b. What is the dependent variable? _____



Lab and Analysis Questions:

1. Describe and explain the relationship between the number of disks floating and time from both data tables. Recall that rate = $\Delta y / \Delta x$
   Determine the initial photosynthesis rate of spinach leaf disks during the experiment and the rates between each of the time points. Record the rates in the table below. Show your calculations! The time at which 50% of the leaf disks are floating (the median) is the point of reference for this procedure. this term is referred to as the ET_{50}.

	Initial 0 to 5	5-10	10- 15	Overall	ET50
Rates (w/o CO2)					
RATES (w/CO2)					
Rates (clear)					
Rates (red)					
Rates (green)					

2. What is the purpose of testing with the presence and absence of CO2?

For the 2nd data table answer the following questions:

3. When is the rate the highest? Explain why.
4. When is the rate the lowest? Explain why?
5. **Predict:** What process (the light dependent or the light independent) cannot occur in the dark treatment? Why does this stop the leaf disks from floating?
6. Why was sodium bicarbonate ($NaHCO_3$) added to the solution?
7. Why was detergent added to the solution?
8. Describe the relationship between the number of discs floating and time, as shown on the graph.
9. Explain the changes that occurred within the leaf tissue that allowed the leaf discs to rise to the surface.
10. Imagine that you had 1-2 additional class periods available for follow-up experiments with a setup similar to this one. Propose another experiment that you could do to test the effect of another factor (other than light) on photosynthesis.

    (a) Question:
    (b) Hypothesis (with reason):
    (c) Outline of procedure for testing hypothesis: