# Exploring Photosynthesis Lab Test

**Instructions:**

This is a test to see how well you can design and carry out a scientific investigation. This test presents a problem. It's divided into two parts. In Part I your task is to plan and design an experiment on your own. You have one class period to complete Part I. Your teacher will review your design and check for safety issues. Once Part I is approved by your teacher you'll go on to Part II. In Part II, you will carry out the experiment you designed in Part I. You'll have one class period to complete your experiment and one additional class period to complete your laboratory report. The scoring rubric that is included with this packet will be used to determine how well you have completed your lab test. You may want to use the rubric as a guide as you complete Parts I and II.

**Background:**

Life needs energy. For much of the earth's living systems that energy is supplied by photosynthesis. The fact that photosynthesis can convert light energy into food energy makes photosynthesis in plants one of the most important of life's processes to understand. Plants use the energy from light to build food molecules of sugar that are rich sources of energy. The chemical equation that summarizes the process of photosynthesis is:

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

Earlier you completed the investigative lab, Photo Finish. In this lab you were introduced to a technique called the floating disk assay. The floating disk assay provides a way to indirectly measure the rate of photosynthesis. It works by timing how long it takes to float leafs disks that have sunk. The sunken leaf disks begin to rise as they accumulate oxygen gas in the spaces between the cells of the leaf as photosynthesis proceeds. In Photo Finish you investigated the differences between the rates of photosynthesis in young leaves versus older leaves. You can review the floating disk assay techniques online in Chapter 8 Investigative Lab or your teacher may have a separate page that reviews the procedure.

## Your Problem to Investigate:

Using the floating disk assay, your problem is to design and carry out an experiment to test the effect of a variable on the rate of photosynthesis. You chose which variable you will investigate. However, **do not** choose the variable of leaf age. It was the variable investigated in the Photo Finish Lab.

Possible Variables to Investigate:

Below is a table of possible variables that provides a starting point for developing questions about photosynthesis to investigate. Of course you may think of other variables to investigate. Look these variables over. Think about how each of these variables might affect the rate of photosynthesis.

| **Environmental Variables** | **Plant or Leaf Variables** | **Method Variables** (These variables may not effect photosynthesis but are still important to investigate) |
|---|---|---|
| ▪ Light intensity (brightness)<br>▪ Light color<br>▪ Temperature<br>▪ Bicarbonate concentration ($CO_2$ source)<br>▪ Direction of incoming light<br>▪ pH of solution | ▪ Leaf color (chlorophyll amount)<br>▪ Leaf size<br>▪ Stomata density<br>▪ Stomata distribution<br>▪ Light starved leaves vs leaves kept in bright light<br>▪ Type of plant | ▪ Size of leaf disk<br>▪ Depth of bicarbonate solution<br>▪ Methods of cutting disks<br>▪ Leaf disk overlap |

**Questions:**

Asking good questions is an important skill. It's important to ask the right question in the right way. A good question for scientific inquiry is asked in a way that actually suggests how the question can be answered. A good question should be focused on how one variable affects another. The resources that are available will also limit your question. Also, for this lab test, remember that you only have one day to do the actual lab work. Make sure your question is answerable in one hour of work.

**Hypothesis:**

Your research question can now aid you in developing a good hypothesis to guide your research or experimental design. A good, working hypothesis helps the investigator limit his or her investigation to the effect of one variable at a time. This allows the results to be clearly interpreted. To develop a working hypothesis, you need to establish the variables that you are studying and make a prediction on how those variables interact. Forming a hypothesis is a two-step process.

1. Define your variables. Determine which variable will change as you manipulate another. Consider the following question. "Does the temperature of germinating seeds affect the rate of cellular respiration?" The temperature of the germinating seeds is the manipulated variable (independent variable) and the rate of respiration is the experimental, or changing, variable (dependent variable).

2. State the relationship between the two variables in an "**If... then**" format. *If* the manipulated variable effects the experimental variable in such and such a way, *then* the experimental variable should change in such and such a manner when the manipulated variable is changed.

**Minimal Materials:**

- Plant leaves
- Two syringes
- Marker
- Bicarbonate/detergent solution in a plastic cup
- Single hole punch
- Strong light source
- Clock or watch
- Safety glasses or goggles (as recommended by your instructor)

**Part I:**

**Your Problem to Investigate:**

Using the floating disk assay, your problem is to design and carry out an experiment to test the effect of a variable on the rate of photosynthesis. You chose which variable you will investigate. However, **do not** choose the variable of leaf age. It was the variable investigated in the Photo Finish Lab.

a) What is the question you will be investigating?
b) Describe the variable you are investigating.
c) State your hypothesis.
d) Generate a materials list that includes the special items you would need for your investigation.
e) Describe the procedure you will use to investigate your hypothesis. Use the rubric as a guide for what to include. List the steps you will use. Describe the type of data that you will collect. You may want include diagrams or illustrations. Be sure to include any safety procedures you will need to follow.
f) Construct a data table that you will use to record your observations. Be sure to correctly label this table and include any important instructions.

Submit your lab test to your teacher after you complete Part I. Do not proceed to Part II until you have your teacher's approval.

**Part II:**

With your teacher's approval carry out the investigation that you have proposed in part I. You may find that you will need to modify your original procedure and data table as you begin to investigate your hypothesis. After completing your lab work complete the Part II worksheet as a lab report. Again, use the scoring rubric as a guide for what is expected in each section of the report.

| Photosynthesis Lab Test, Part I | Your Name: |
| --- | --- |

***Question:***

***Identification of Variables:***

***Hypothesis:***

***Materials:***

***Procedure:***

***Data Collection & Presentation:***

| Photosynthesis Lab Test, Part II | Your Name: |
| --- | --- |

***Question:***

***Identification of Variables:***

***Hypothesis:***

***Materials:***

***Procedure:***

***Data Collection & Presentation:***

***Conclusion:***

# Lab Test Rubric

(modified from a rubric used by the Olathe East High School Science Department, Olathe, KS)

**Standards: The levels at which students are expected to perform the task**

| Score | | Advanced (5) | Proficient (3) | Needs Improvement |
|---|---|---|---|---|
| _____ | ***Question*** | · Question is narrowly focused and suggests how an answer might be investigated. It is answerable. | · Question is answerable but not narrowly focused. | · Question is too broad and n practically investigated. |
| _____ | ***Identification of Variables*** | · Correctly identifies specific, measurable independent and dependent variables. | · Identifies variable being tested & variable being measured. | · Variables and constants significantly incomplete &/ inaccurate. |
| _____ | ***Hypothesis*** | · Hypothesis is testable and clearly stated in "If… then…" format. Specifically predicts relationship between dependent and independent variables. | · Hypothesis is clearly stated. It predicts the influence of one variable on another. | · Hypothesis is poorly stated doesn't directly mention th variables. |
| _____ | ***Materials*** | · Complete, detailed list of materials (size, conc., quantity) presented in vertical list format. | · Most materials are listed and appropriate. | · Materials quite incomplete inappropriate for experimer |
| _____ | ***Procedure*** | · Accurately tests the hypothesis | · Attempts to test hypothesis | · Does not address hypothesi |
| _____ | | · Conducts or analyzes at least 3 trials. | · Multiple trials attempted or need is recognized. | · Single trial, poor understan use of multiple trials. |
| _____ | | · Procedure is in vertical list format, accurate, complete, easy-to-follow, and reproducible by another person. Includes diagrams to clarify procedures. | · Step-by-step procedure, generally complete. Minor errors/ omissions make it difficult to follow or not always repeatable. | · Procedure difficult to follo Major omissions or errors. |
| _____ | | · Includes all appropriate safety concerns. | · Includes critical safety concerns. | · Safety concerns trivial or inadequately addressed. |
| _____ | ***Data Collection & Presentation*** | · Data table contains accurate, precise raw data & summary data reported in correct SI units with descriptive title. | · Data table with accurate data, most units labeled or implied. Minor errors. Title absent or trivial. | · Data table inaccurate, confu and/or incomplete. Missing |
| _____ | | · Data summarized in well-organized, easy-to-read graph &/or figures. Descriptive title, appropriate labeling, keys, etc. | · Data displayed in well organized easy to read graph &/or figures. Descriptive title, minor errors in use of units and labeling. | · Graph/figures presented in confusing and/or sloppy fas |
| _____ | | · Data summarized in a clear, concise, logical manner. Patterns identified & described, but no conclusions drawn. | · Reasonable, but somewhat unclear summary of data. Patterns in data not clearly identified. | · Summary is unclear and ill Patterns in data not identifi |
| _____ | ***Conclusion*** | · Scientifically valid, logical conclusion, well supported by the data collected. Clearly addresses problem and stated hypothesis. | · Scientifically valid, logical conclusion, supported by data collected. Attempts to address problem and stated hypothesis. | · Conclusion is incomplete o illogical. Does not address problem and hypothesis. |
| _____ | | · Sources of error identified and explained. Appropriate recommendations made to eliminate errors. | · Sources of error identified. | · Weak/trivial attempt to ide sources of error. |
| _____ | | · Student generates specific questions for future study. | · Student makes attempt to generate questions for future study. | · Student makes incomplete inappropriate attempt to ex apply knowledge. |