Writing a Proposal: Photosynthesis

Introduction

A proposal is a document describing in detail a piece of research you are planning to undertake. The proposal must convince the reader that the proposed research is useful, and that you fully understand how to do it.

Below you will find some notes about photosynthesis and respiration in plants. Use these notes to write a proposal for a set of simple qualitative experiments to show what conditions are required for photosynthesis to occur in plants, and what gases are absorbed and emitted by the plants during photosynthesis and respiration.

Your proposal should include:

- The theory underlying the experiments.
- The objective of each experiment.
- The methods to be used and what observations will be made.
- How conclusions will be drawn from the results.

Think carefully about how the experiments must be done to ensure that the objectives of the experiments are achieved and that the conclusions drawn from the results are true.

Theory of Photosynthesis and Respiration in Plants

Green plants produce carbohydrates (sugars and starch) by **photosynthesis**. To do this plants need carbon dioxide, water, light and chlorophyll.

Carbon dioxide enters the plant through small holes in the leaves; water enters through the roots. The carbon dioxide and water then produce sugars and oxygen with the help of light and chlorophyll in the leaves. Chlorophyll absorbs red light and violet light for photosynthesis and reflects green light.

Photosynthesis has two steps:

1. **The light reaction** in which light energy splits water and oxygen gas is given off.
2. **The dark reaction** in which hydrogen from the split water produces sugar from carbon dioxide.

The net sum of the two reactions is

$$6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2.$$

The sugar ($C_6H_{12}O_6$) is then changed to starch ($nC_6H_{10}O_5$) and stored temporarily in the leaf.

Respiration is the process by which a carbohydrate is broken down by oxygen to produce energy, carbon dioxide and water. The net chemical reaction in respiration is the reverse of the photosynthetic reaction.

Respiration occurs in plants all the time (day and night). It is slower than photosynthesis, so photosynthesis is the main reaction in the daytime. At night respiration is the only reaction; photosynthesis is not possible in the dark.

Testing Methods

To **test a leaf for the presence of starch**, the leaf is:

1. Dipped in boiling water to remove the waterproof covering.
2. Boiled in ethanol to remove the chlorophyll.
3. Treated with dilute iodine solution.
4. Washed to remove the iodine.

A blue-black color in the leaf then indicates the presence of starch.

A **potassium hydroxide solution** absorbs carbon dioxide from air.

Oxygen gas ignites a glowing stick of wood.

The color of a **bicarbonate indicator** shows changes in the carbon dioxide level in air as follows:

- **Yellow:** when CO_2 is added.
- **Red:** when the CO_2 level is normal.

- **Purple:** when CO_2 is removed.

Starch in Photosynthesis and Respiration

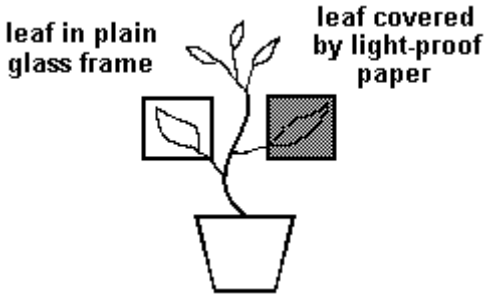
If a plant is kept in the dark for 48 hours and some of its leaves are then tested with iodine, the absence of a blue-black color will show that all the starch in the leaves has been used up by respiration.

If the same plant is then exposed to sunlight for six hours and some of its leaves are tested with iodine, the presence of starch in the leaves will show that starch has been produced by photosynthesis.

If starch is found in the leaves of a plant at the end of an experiment, it can be concluded that the starch was produced by photosynthesis during the experiment *provided that the leaves did not contain any starch at the beginning of the experiment*.

State in your proposal how these facts are used to prepare plants for the experiments and show when photosynthesis has occurred.

The Need for Light in Photosynthesis

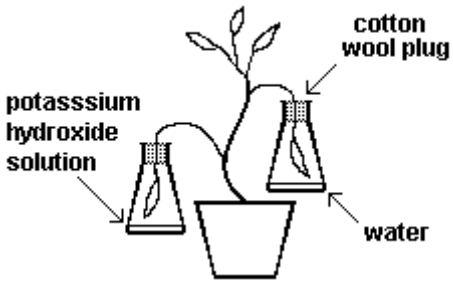


Apparatus.

Objective, Method, Observations and Conclusion

State in your proposal how this apparatus can be used to test the need for light in photosynthesis. Instead of preparing individual leaves as shown it would also be possible to use two similar plants, one plant exposed to the light and the other plant kept under a dark cover.

The Need for Carbon Dioxide in Photosynthesis



Apparatus.

Objective, Method, Observations and Conclusion

State in your proposal how this apparatus can be used to test the need for carbon dioxide in photosynthesis. Instead of preparing individual leaves as shown it would also be possible to use two similar plants, one plant enclosed in a vessel where potassium hydroxide solution removes carbon dioxide from the surrounding atmosphere and the other plant in a vessel containing only pure water.

The Need for Chlorophyll in Photosynthesis

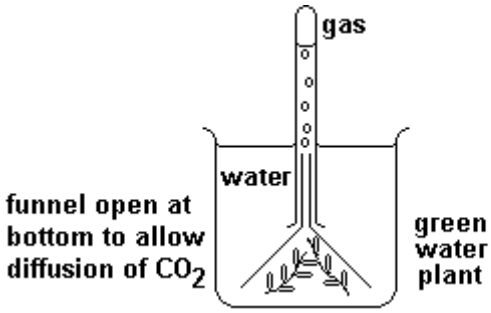
A varigated leaf.

Varigated leaves are partly green and partly white. The green parts contain chlorophyll and the white parts do not.

Objective, Method, Observations and Conclusion

State in your proposal how a plant with varigated leaves can be used in an experiment to test the need for chlorophyll in photosynthesis. Your experiment should find out where in the leaves starch is produced.

The Production of Oxygen in Photosynthesis



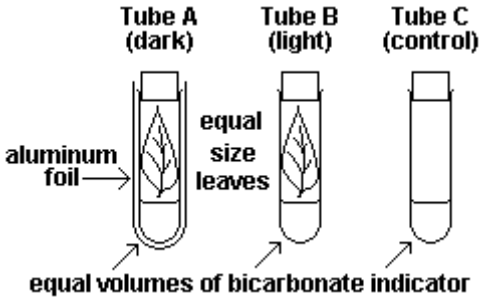
Apparatus.

The apparatus shown can be used to collect the gas given off by a green water plant.

Objective, Method, Observations and Conclusion

State in your proposal how an experiment can be done to show that oxygen is given of by the plant during photosynthesis but not in the absence of light.

Carbon Dioxide Exchanges in Plants During Photosynthesis and Respiration



Apparatus.

Method

When three glass tubes, two of which contain leaves as shown, are exposed to sunlight for two hours, the colors of the indicators observed in the tubes at the start and the end of the experiment are shown in the table below. Note that Tube A is kept in the dark by the aluminum foil, Tube B is exposed to the sunlight, and Tube C does not contain a leaf.

Table of Results

Time (h)	Tube A (dark)	Tube B (in sunlight)	Tube C (control)
0	red	red	red
2	yellow	purple	red

Discussion

What do these results imply about the exchanges of carbon dioxide between the leaves and the surrounding air during photosynthesis and respiration? Include this experiment in your proposal.

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