

PHOTOSYNTHESIS – THE PRACTICALS

17 APRIL 2013

Lesson Description

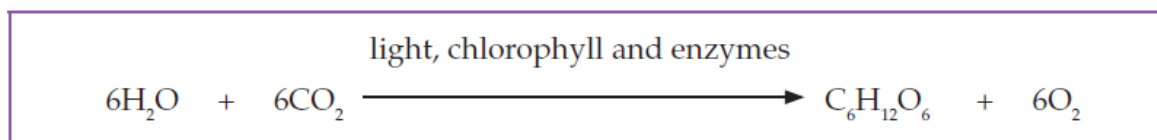
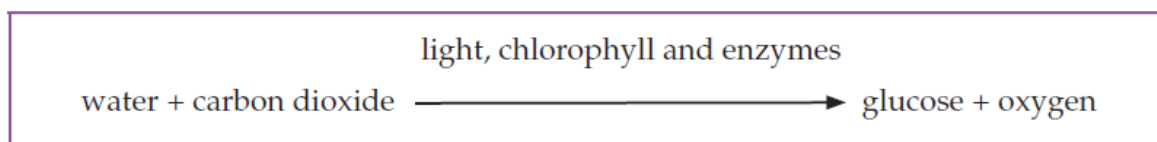
In this lesson, we will:

- Review the process of photosynthesis
- Study the starch test in leaves
- Study the various practical's testing photosynthesis
- Look at how to complete a practical write-up

Key Concepts

Review the Process of Photosynthesis

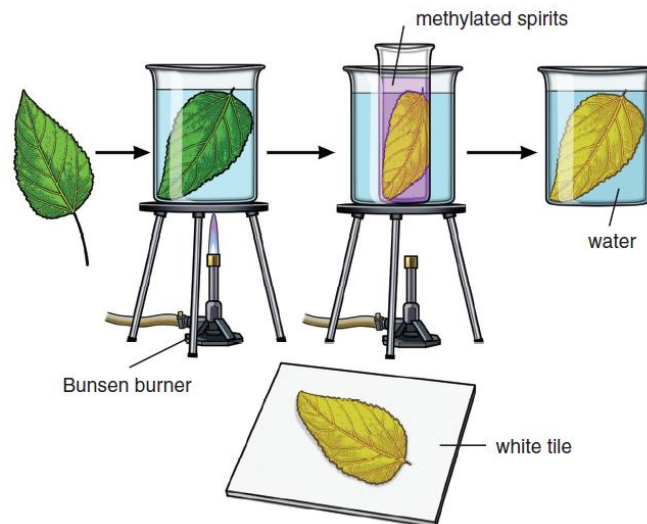
- Photosynthesis is a process whereby light is converted into chemical energy. Sunlight is changed into the chemical energy of sugars and other organic compounds. This process consists of a series of chemical reactions that require carbon dioxide (CO₂) and water (H₂O) and store chemical energy in the form of sugar.
- Photosynthesis occurs in the chloroplast. It is an anabolic process and requires enzymes.



(Solutions for all Life Sciences, Grade 11, Macmillan, Page 121)

Starch Test in Leaves

- The first thing you need to be able to do is to test for starch. The test for starch goes as follows:
- You will need the following:
 - A beaker containing water
 - Tripod stand and wire gauze
 - Bunsen burner or spirit burner
 - Test tube containing methylated spirits
 - Forceps
 - White tile
 - Iodine solution
 - Dropper or pipette



(Solutions for all Life Sciences, Grade 11, Macmillan, p128)

- If you don't have access to a laboratory you can still perform the experiment but with a few changes:
 - A small pot containing water
 - A stove or gas stove
 - Some methylated spirits (keep away from the flame – always!)
 - Something to take the leaf out of the hot water – fork or tweezers
 - White paper with plastic over it
 - Iodine solution (from pharmacy)
 - Dropper
- Method:
 - Remove a leaf from a healthy growing plant.
 - Put the leaf in boiling water
 - When the leaf has gone soft (flaccid) take it out of the water and put it into methylated spirits. (Keep the spirits away from flame.)
 - The chlorophyll will move out of the leaf and into the methylated spirits.
 - Remove the leaf from the methylated spirits and wash it in the boiling water.
 - Put the leaf onto the white tile and flatten it out.
 - Drop a few drops of iodine solution onto the leaf and watch for a colour change.



(<http://hazell11bio.blogspot.com/2013/03/photosynthesis.html>)

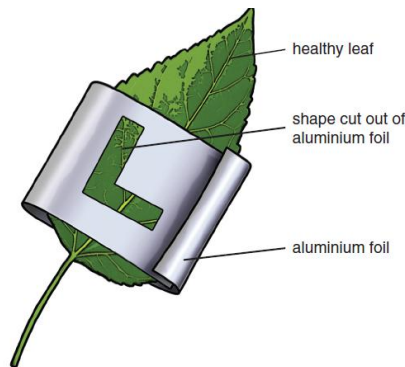
Photosynthesis Practicals

Practical 1

To determine whether light is necessary for photosynthesis

- Requirements:
 - Pot plant that has been kept in the dark for 48 hours
 - Tin foil
 - Scissors
 - Starch test materials

- Method:
 - Cut a shape into a wide strip of tinfoil.
 - Wrap the tin foil around the leaf with the shape on the top of the leaf. You don't have to cover the whole leaf.
 - Leave the plant in the sun for several hours.
 - After several hours remove the leaf from the plant and perform the starch test on it.



(Adapted from Solutions for all Life Sciences, Grade 11, Macmillan, p129)

Practical 2

To determine whether chlorophyll is necessary for photosynthesis

- Requirements:
 - Plant with variegated leaves left in the dark for 48 hours
 - Starch test materials

- Method:
 - Remove the plant from the dark and put it into the sun for several hours.
 - Perform the starch test on a leaf.



(<http://landscaping.about.com/od/galleryoflandscapephotos/ig/variegated-leaves/variegated-maples.htm>)

- Result:
 - There will be starch present where the green parts of the leaf were and no starch in the white areas.

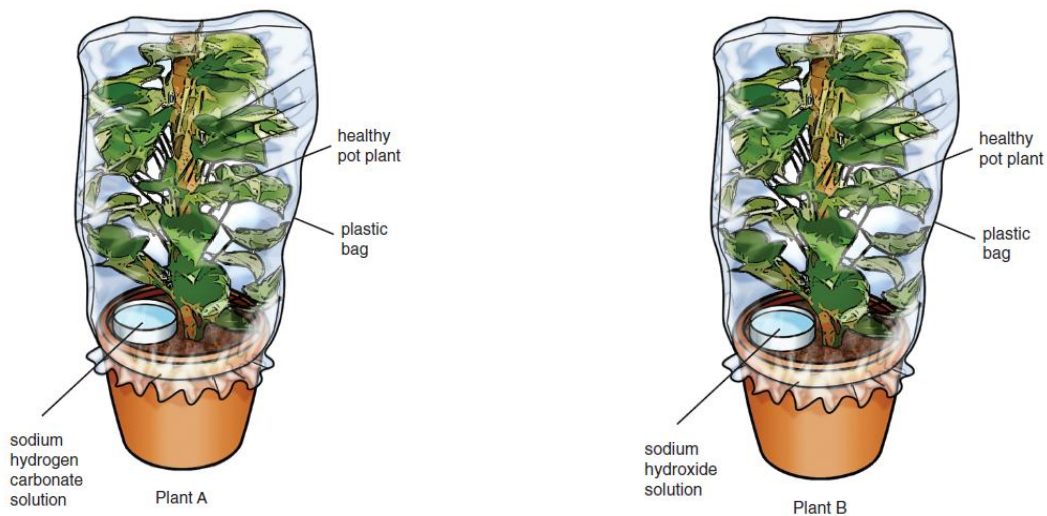


(http://science.taskermilward.org.uk/mod1/Year%209/Yr9Biol/9Biol_1.htm)

Practical 3

To determine whether carbon dioxide is necessary for photosynthesis

- Requirements:
 - 2 pot plants left in the dark for 48 hours
 - Sodium hydroxide solution (NaOH)
 - Sodium hydrogen carbonate solution (NaHCO₃)
 - 2 large plastic bags
 - 2 elastics
 - Starch test materials
- Method:
 - Remove the plants from the dark
 - Place a container of sodium hydroxide on the soil of one plant.
 - Place a container of sodium hydrogen carbonate on the soil of the second plant.
 - Cover both plants with a plastic bag and secure with the elastics.
 - Leave the plants in the sun for several hours.
 - Remove a leaf from each plant
 - Perform the starch test on each leaf.



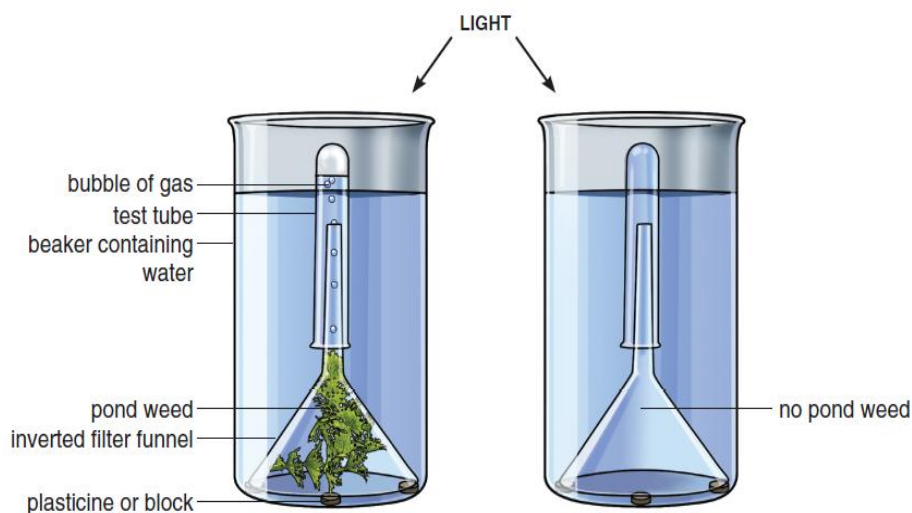
(Adapted from *Solutions for all Life Sciences*, Macmillan, p131)

- Result:
 - The plant that had sodium hydroxide with it in the plastic bag will produce less starch.
 - The plant that had sodium hydrogen carbonate with it in the plastic bag will produce more starch.

Practical 4

To determine whether oxygen is produced during photosynthesis

- Requirements:
 - Two beakers
 - Water
 - Two filter funnels
 - Two test tubes
 - Prestick
 - Canadian pond weed (*Elodea*)
 - 2 elastics
 - A wooden splint
 - matches
- Method:
 - Pour water into the two beakers
 - Place the *Elodea* in one beaker
 - Place the funnel upside down over the *Elodea* and use prestick to keep it above the bottom of the beaker
 - Place a funnel upside down in the second beaker also slightly elevated
 - Fill a test tube with water and close it with your thumb
 - Place it over the top of the funnel
 - Leave the beakers in the sun for several days
 - After a few days remove the test tube from the *Elodea* and close it with your thumb
 - Light a splint and blow it out.
 - Remove your thumb from the top of the test tube and put the splint in.



(Adapted from *Solutions for all Life Sciences, Grade 11, Macmillan, p132*)

Practical Write Up

- **Investigative question** – this is the purpose of the investigation. The question we are trying to answer by completing the experiment.
- **Hypothesis** – the answer you expect to get from the investigation
- **Method and materials** – what you are going to use and how you are going to perform the experiment
- **Variables** –
 - **Independent** – the factor you are changing to answer your question
 - **Dependent** – the factor that changes because of what the Independent variable does (the answer to the question)
 - **Controlled** – the factor that can change but you make sure does not change at all during your experiment
- **Results** – what you have recorded as the answers to your Investigative question
- **Analysis** – an explanation of your results
- **Conclusion** – Drawing the whole practical together summarising the question, hypothesis and results.

Questions

Question 1

Look at the practical we have just performed and answer the questions that follow:

- a.) What is the investigative question for this practical? (2)
- b.) Write an appropriate hypothesis for this practical. (2)
- c.) There are several variables involved in this practical. State the following variables:
 - i. Controlled variable (1)
 - ii. Independent variable (1)
 - iii. Dependent variable (1)
- d.) What results do you record? (2)
- e.) State a suitable conclusion to this experiment. (3)

Question 2

(Adapted from *Solutions for all Life Sciences, Grade 11, Macmillan Enrichment Activity, p136*)

Design an investigation

Conrad observed that a water plant in a beaker of water produced different numbers of bubbles at different times of the day (see Figure 2.1). The water plant seemed to produce a lot of bubbles when it was bright and sunny and fewer bubbles in the early morning and late afternoon when there was not as much light. Conrad's teacher told him that the bubbles produced by the plant were oxygen gas given off by the plant during photosynthesis. Conrad thought of a hypothesis based on his observation: 'An increase in light intensity causes an increase in the rate of photosynthesis'. He decided to test his hypothesis in a simple investigation. The aim of the investigation was: 'To determine whether an increase in light intensity causes an increase in the rate of photosynthesis'.

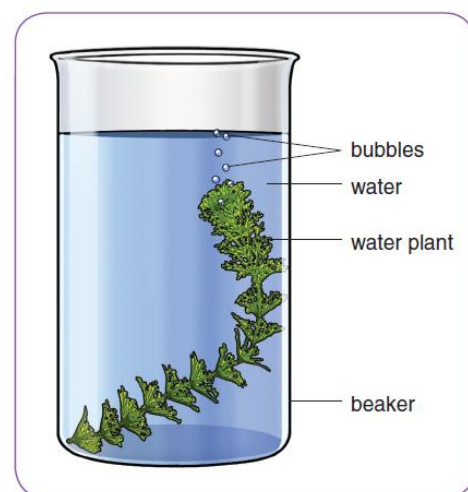


Fig. 2.1 Conrad's observation

Conrad worked out a method for his investigation and selected the apparatus that he would need (see Figure 2.2).



- a.) Use the information that you have been given in the case study to work out a method that you could use to carry out this investigation. Use only the apparatus that is shown in Figure 2.2. (12)
- b.) Identify the independent variable, the dependent variable and at least one controlled variable for this investigation. (7)
- c.) Describe any safety precautions that you would take in carrying out the investigation. (2)
- d.) Design a table to collect the results of the investigation. (3)