Investigation of the factors affecting photosynthesis

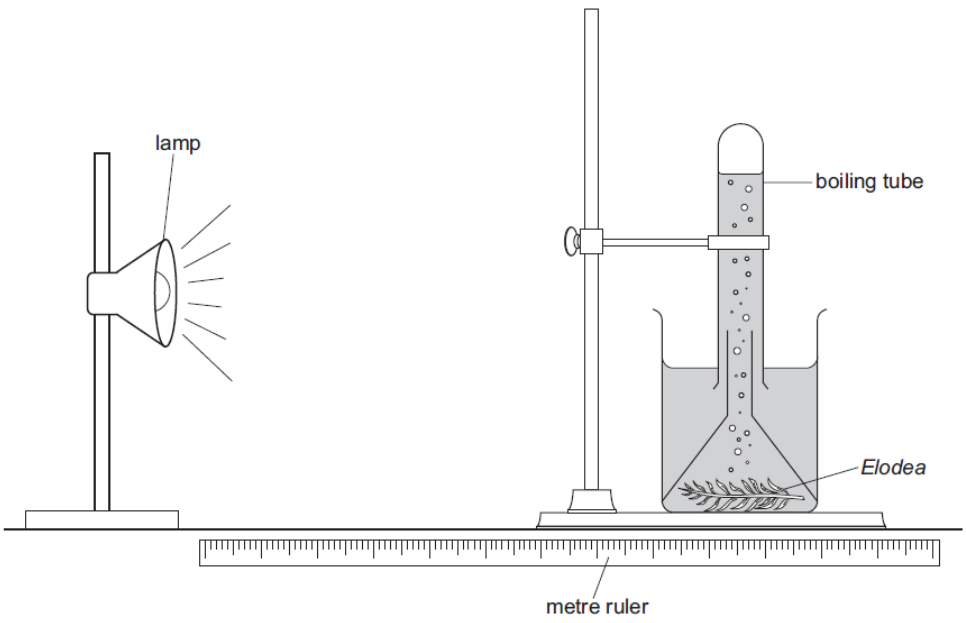
Introduction

Light is one of the factors which affects the rate of photosynthesis.
In this investigation a green plant named Canadian pondweed *(Elodea)* will produce bubbles of oxygen as a result of photosynthesis.
The number of bubbles of oxygen produced is affected by light intensity.

Apparatus

250 cm^3 beaker
lamp
glass funnel
plasticine
test tube
8 cm length of pondweed (*Elodea)*
metre ruler ± 1 mm
sodium hydrogen carbonate powder
clamp stand, clamp and boss
spatula

Diagram of Apparatus



Method

1. Place the *Elodea* in a beaker containing 200 cm^3 of water.
2. Add one spatula of sodium hydrogen carbonate to the water.
3. Stick 3 small pieces of plasticine to the rim of the funnel and place it upside down over the plant.
4. Completely fill a test tube with water and carefully place over the end of the funnel with the end under the water, clamp into place.
5. Place the lamp 5 cm away from the apparatus.
6. Start the stopwatch and record the number of bubbles of oxygen produced in one minute.
7. Repeat the experiment with the lamp 10 cm, 15 cm, 20 cm, 25 cm and 30 cm from the apparatus.

Analysis

1. Plot a graph of the distance against number of bubbles produced in 1 minute.
2. What conclusions can be reached from your results?
3. Evaluate your method and state how it could be improved.

Risk Assessment

Hazard	Risk	Control measure
Lamps will become hot	Burning hand when moving lamp	Do not touch lamp until it has cooled down.

Teacher/Technician notes

If the plant is not producing bubbles then the stem might have started to 'heal' up, cutting off the end off may improve bubbling.

Begin the experiment with the lamp closer to the plant and move the plant further away as this seems to give better results.

Cabomba caroliana (and *Elodea crispa*) are no longer available to buy. They have been banned for culturing or sale under European regulations controlling invasive non-native plants. CLEAPSS have worked with native plants (Hornwort and red Cabomba), and they are OK for use. The CLEAPSS method (see the link below) overcomes the problems of the native aquatic plants bubbling slowly.
http://science.cleapss.org.uk/Resource-Info/GL184-Using-video-recording-to-measure-the-rate-of-photosynthesis.aspx

If students have any difficulty in obtaining results, the link below can be used.

http://www.reading.ac.uk/virtualexperiments/ves/preloader-photosynthesis-full.html

The method as stated does not include repeats, but students should be encouraged to carry out an appropriate number, if time allows.

This experiment is ideal for a discussion of the limiting factors of photosynthesis and how they are controlled variables in this experiment. There is also a clear opportunity to discuss the limitations of the investigation such as the difficulty in controlling temperature.

Students should design their own table, but a suggested table format is shown below.

	Number of bubbles produced in one minute			
Distance from plant to lamp (cm)	**Trial 1**	**Trial 2**	**Trial 3**	**Mean**

Practical techniques covered

B1 Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH.

B2 Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater.

B3 Use of appropriate apparatus and techniques for the observation and measurement of biological changes and or processes.

B4 Safe and ethical use of living organisms (plants or animals) to measure physiological functions and responses to the environment.

B5 Measurement of rates of reaction by a variety of methods including production of gas, uptake of water and colour change of indicator.