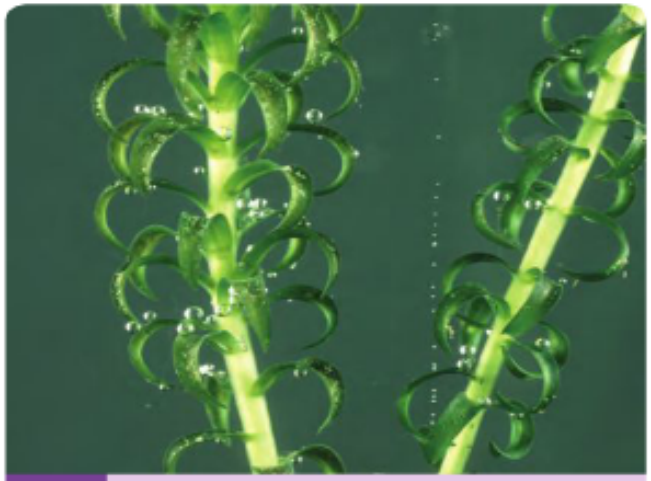
11 - Photosynthesis

In this activity *Elodea* or pondweed is used. *Elodea* is an underwater plant, so it is possible to see the bubbles of oxygen released from the plant as they pass through the water.

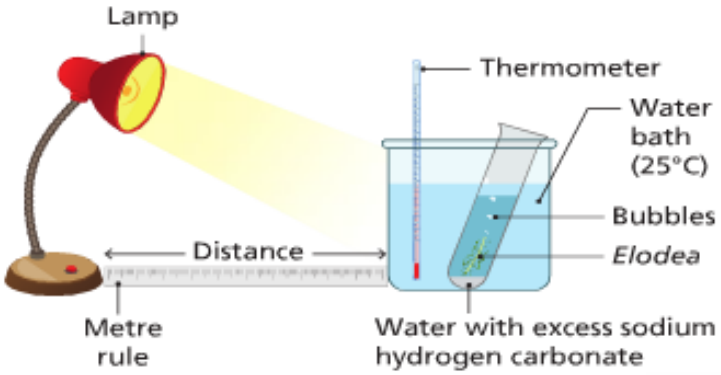
The rate of photosynthesis is measured by counting the number of bubbles released in a given time.

1. Add excess sodium bicarbonate (also called sodium hydrogen carbonate) to some water in a test tube. This means that water is saturated with carbon dioxide (which ensures a constant concentration of carbon dioxide during the experiment).
2. Cut a section of *Elodea* and place it (cut end upwards) in the test tube. Set up the apparatus as shown in diagram 11.20 in a darkened room. (The water bath ensures that the temperature stays constant.) The lamp should be 1 metre from the apparatus.
3. Leave the apparatus for 5 minutes (to allow the *Elodea* to adjust to the conditions).
4. Count the number of bubbles of oxygen coming from the cut end of the stem per minute.
5. Repeat step 4 twice more.

Syllabus There is a choice of activity here. This account refers only to the influence of **light intensity** on the rate of photosynthesis.



11.18 *Elodea: note the bubbles of oxygen*



6. Add the three numbers and divide by 3 to calculate the average number of bubbles per minute (this is a measure of the rate of photosynthesis).

11.19 *To investigate the effects of light intensity on the rate of photosynthesis*

7. Increase the light intensity by moving the lamp closer to the apparatus.
8. Repeat steps 3 to 6 each time the lamp is moved (i.e. at 80 cm, 60 cm, 40 cm and 20 cm).
9. Record your results as shown in the following table (some values are included as samples).

Activity 12 results		
Distance (cm)	**Number of bubbles/minute**	**Average number of bubbles/minute**
100	8, 10, 9	9
80	12, 14, 13	13
60		
40		
20		

10. You will see that as the lamp is moved closer to the apparatus the rate of bubble production increases. However, at some point, the rate of bubble production ceases to increase. The plant is then said to be saturated with light.

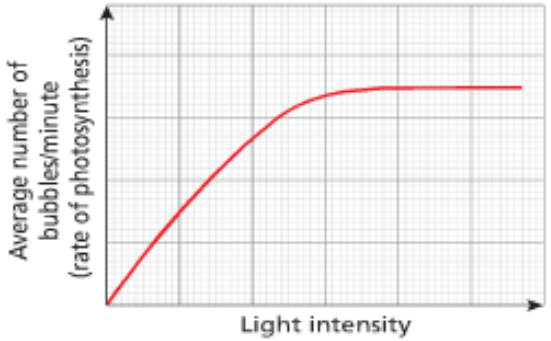
$$\text{Light intensity} \propto \frac{10\,000}{(\text{distance})^2}$$

11.20 *The formula to use to convert from distance (in cm) to light intensity where the symbol means 'is proportional to'.*

The final table of results (based on the figures in step 9) will appear as:

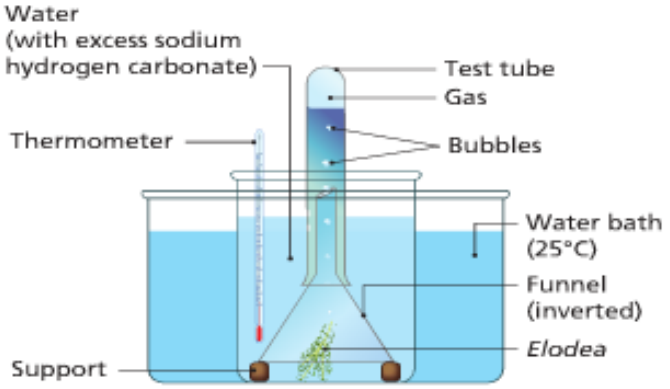
Distance (cm)	Light intensity	Average number of bubbles/minute
100	1	9
80	1.56	13
60	2.78	
40	6.25	
20	20	

11. Draw a graph of the average number of bubbles/minute vs. light intensity (putting light intensity on the horizontal axis). The graph should appear as shown below.



11.21 *Graph showing bubble rate against light intensity*

Note: This experiment can also be carried out using the apparatus shown in diagram 11.22.



11.22 *Alternative apparatus*

In this case the rate of photosynthesis can be calculated by:

- Counting the number of bubbles/minute
- Measuring the volume of oxygen gas collected in the top of the test tube after a suitable length of time (e.g. 15 minutes).

In addition, the gas collected in the test tube can be shown to be oxygen, as it rekindles a glowing splint.