Investigating photosynthesis

Transcript

During photosynthesis in plants, carbon dioxide from the air joins with water to make glucose and oxygen. Oxygen gas is released from the plant as a waste product.

The volume of oxygen released during photosynthesis can be represented by the number of oxygen bubbles a plant releases. This in turn, can be used to approximate the rate of photosynthesis in the plant.

This experiment investigates how varying light intensity affects the rate of photosynthesis in an aquatic plant.

Aquatic plants are used because it is easy to see bubbles coming from them when they are submerged in water. The same plant will be used throughout the experiment as different plants, even of the same type, will have different rates of photosynthesis.

The distance of the lamp from the plant is used to represent changes in light intensity. When the lamp is closer to the plant, this represents a higher light intensity than when the lamp is further away.

Temperature affects the rate of photosynthesis, so a water bath is used to keep the temperature of the plant constant.

The water bath is prepared by filling a large beaker with tap water. The water is left to reach room temperature while the rest of the experiment is set up.

A single piece of the aquatic plant is selected.

A pair of scissors is used to cut it to 5cm in length. Any excess is placed back into the original container.

A paperclip is added to the uncut end. This helps to weigh the plant down.

The plant is placed, paperclip first, into a boiling tube.

The cut end must be towards the top.

A fresh beaker is filled with pond water. It is best to use the pond water rather than tap water because this will better reflect the plant's normal conditions.

The boiling tube is filled almost to the top directly from the large glass beaker or by using a syringe.

The boiling tube is placed into the water bath, and is carefully clamped in place.

More room temperature water is added to the water bath so that all of the aquatic plant is insulated.

A metre ruler is placed on the lab bench in front of the beaker.

A bench lamp is positioned at the 50 cm mark on the ruler.

The lamp is turned on and all other sources of light are reduced where possible.

The plant is given time to adjust to the new light intensity by leaving it for 3–4 minutes before starting to count bubbles.

Then, the timer is started and the number of bubbles leaving the cut end of the aquatic plant in one minute is counted using a tally chart.

The total number of bubbles is recorded in a table.

The measurement is repeated two more times at this distance. The total number of bubbles given off in one minute for each repeat is recorded.

The mean number of bubbles released in one minute is calculated, and rounded to the nearest whole number. The mean value helps to reduce the effect of any anomalies.

Keeping all other conditions the same, the lamp is moved to 40 cm.

As before, counting doesn't start until 3 to 4 minutes has passed.

The number of bubbles released in one minute is counted.

This is repeated two more times and the mean is calculated as before.

Keeping all other conditions the same, the lamp is moved to 30 cm from the beaker and the plant is left to adjust to the light for 3 to 4 minutes. Then the number of bubbles are counted as before.

This is repeated two more times at this distance and a mean is calculated.

Keeping all other conditions the same, the lamp is moved to 20 cm and the plant left to adjust for 3 to 4 minutes.

The number of bubbles released in 1 minute is recorded as before.

This is repeated two more times and the mean is calculated.

The lamp is moved to 10 cm, the plant is left to adjust, and the number of bubbles released is counted.

This is repeated two more times and the mean is calculated.

The rate of photosynthesis in this experiment is represented by the mean number of bubbles of oxygen released per minute.

So for example, the rate of photosynthesis of the plant at 10 cm was 45 bubbles per minute.

The results are plotted on graph paper.

The distance of the lamp in centimetres is plotted on the *x*-axis as it's the independent variable. The rate of photosynthesis is plotted on the *y*-axis as it is the dependent variable.

A smooth curve of best fit is drawn through the plotted points

The curve slopes downwards as the distance from the plant increases, suggesting that as the distance increases the rate of photosynthesis decreases.

Remember that the distance of the lamp from the aquatic plant is used here to approximate a change in light intensity. So, the curve shows that as the light intensity decreases, the rate of photosynthesis decreases. Why do you think this is?

Plants need light to photosynthesise, so it makes sense that when the light intensity is very low, the rate of photosynthesis is also low because the plant does not have sufficient light.

It also follows that, at the lower light intensities, increasing the light intensity will lead to an increase in the rate of photosynthesis; as indicated by the slope of the curve. In other words, the more light there is available to the plant, the more photosynthesis that can take place.

However, the rate of photosynthesis recorded at 20 cm from the plant was the same as that recorded at 10 cm from the plant. The straight line here suggests that above a certain light intensity, increasing the light intensity further will no longer increase the rate of photosynthesis.

Why do you think this is?

A plant also requires carbon dioxide, water and chlorophyll to photosynthesise. At very high light intensities, the plant already has as much light as it can use, so it is another factor that is preventing photosynthesis from occurring any faster.

This experiment shows that varying the light intensity affects the rate of photosynthesis. This is why many plants have features that help them to better absorb light, and why you often see plants growing towards light.