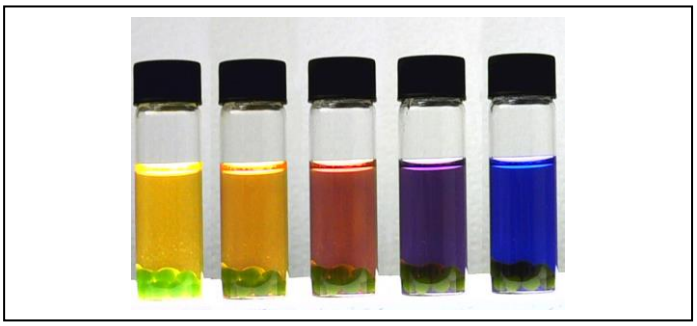
Algal Ball Photosynthesis Kit (L1.60)

Experiments that allow photosynthesis to be studied in a reliable way are generally difficult to set up. To address this problem, we are pleased to offer the Algal Ball Photosynthesis kit. The "algal balls" are placed in small transparent vials of hydrogen carbonate indicator solution. During photosynthesis, the encapsulated algae takes up CO_2 from the surrounding solution. As the concentration of dissolved CO_2 becomes lower, the pH of the solution rises due to the reduced amount of carbonic acid in the solution. You can follow the shifting pH by monitoring the colour of the hydrogen carbonate indicator.



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Contents

Quantity	Description	Re-Order Code
1	Container of 60 algal balls in distilled water	L1.61
5	Empty vials (7mL volume) for experimental use	G7.55 (pack of 20 vials)
1	Bottle (50mL) of hydrogen carbonate indicator	SI20
6	Plastic pipettes	G10.73 (pack of 100 pipettes)
1	Explanatory notes	

Re-ordering

To order more Algal Ball Photosynthesis Kits, use product code L1.60.

To order the individual components of the kit, use the product codes shown above under the “Re-Order Code” heading.

On Arrival

When your kit arrives, take care to remove the container of algal balls. If you cannot use it immediately, place it where it will stay cool and get plenty of indirect light. Avoid placing it in direct sunlight or near a source of heat. It will help to loosen the lid to allow fresh air in, but take care to protect it from knocks that would lead to spillage. For best results, use the algal balls as soon as possible, but in any case, within 2 weeks.

Preparation

1. To prepare for your experiments, rinse the first of your experimental vials with approximately 1mL of hydrogen carbonate indicator solution. Rinse by capping the vial and shaking, then pour the rinse liquid into the second vial. Repeat this process for each vial that you wish to use, then discard the rinse liquid from the last vial.
2. Count the required number of algal balls into each vial, then use a plastic pipette to add 3mL of hydrogen carbonate indicator to each vial.
3. Observe the colour changes of the indicator solution as the concentration of dissolved CO_2 changes and the pH varies. When kept in the dark, respiration will dominate and the pH will go down as CO_2 is released, causing the colour of the indicator solution to go yellow. Under illumination, as photosynthesis occurs, CO_2 will be taken up by the algae and the pH will rise, causing the colour of the indicator solution to go from yellow through red to purple.

Experiments

Each of the algal balls in a given batch is close enough in size and algal concentration to be considered the same as all the others in the batch. This is what makes it possible to perform quantitative experiments. Here are some possible approaches you can consider.

1. Demonstration

Prepare a vial of algal balls and hydrogen carbonate indicator and place it near a light source in such a way that it will receive illumination but not become too hot. Observe the colour change from yellow/orange to purple as photosynthesis takes up dissolved CO_2 and the pH rises.

After a period of illumination, put the vial in the dark for some time. For example, cover it with a small box. Observe the colour change from purple to yellow/orange as respiration occurs and the pH falls.

Respiration and photosynthesis occur simultaneously in the algal cells. As more light becomes available, photosynthesis dominates. However, as conditions become darker, photosynthesis is retarded and respiration takes over as the main process.

2. Coloured Light Filter

Prepare a vial of algal balls and hydrogen carbonate indicator and place it near a light source in such a way that it will receive illumination but not become too hot. Place a coloured light filter between the light source and the vial. For example, wrap a piece of coloured transparent film around the vial. Try different colours and see if the colour of the transmitted light affects the rate of photosynthesis.

3. Varying the Number of Algal Balls per Vial

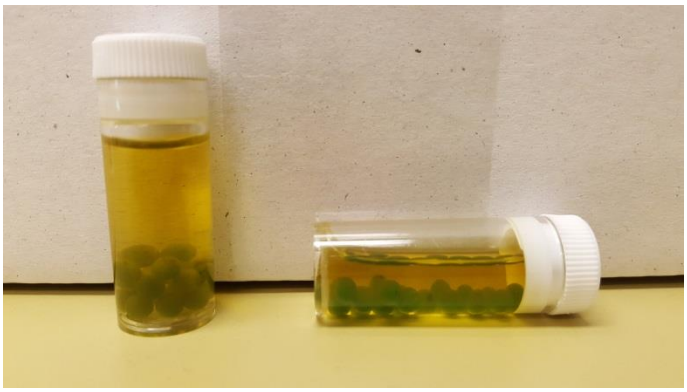
Prepare a number of vials of algal balls and hydrogen carbonate indicator. Vary the number of balls and place each vial the same distance from a light source in such a way that they will receive illumination but not become too hot. Check if the number of algal balls can be correlated with the rate of change of pH.

4. Varying the Light Intensity

Prepare a number of vials of algal balls and hydrogen carbonate indicator. Place the same number of balls in each vial. Put each vial at a measured distance from a light source, taking care not to allow any vial to cast a shadow on any other. See how the rate of change of pH is influenced by the light intensity.

5. How many balls to use?

Generally, for a given level of illumination, the more balls you place in a vial, the quicker the pH will change. However, overpacking the vial will cause some balls to be hidden behind others where they cannot photosynthesise efficiently because they are in shadow. Lying the vial down and illuminating from above will allow the balls to spread out rather than stack on top of each other. As a guide, you can place up to 12 balls in a vial before they begin to stack and block light from their neighbours.



Avoid overpacking the vial with algal balls and consider positioning the vial on its side with a light source above it to ensure optimum illumination.

Evaluating Your Results

Hydrogen carbonate indicator is sensitive enough to change colour as CO_2 dissolves in water to form carbonic acid.

$$CO_2 + H_20 \leftrightarrow H_2CO_3$$

The indicator is a red/orange colour in water that is in equilibrium with the CO_2 in the air. The colour shifts through orange to yellow as the concentration of dissolved CO_2 rises and the pH falls, and it shifts through red to purple as the concentration of dissolved CO_2 falls and the pH rises. A rise in the concentration of CO_2 occurs during respiration as the algae breaks down sugars to release energy, CO_2 and water. A fall in the concentration of CO_2 occurs during photosynthesis as the algae produces carbohydrates by taking up CO_2 and water and absorbing light energy.

You can compare the colour of the indicator solution in your experimental vials to a set of standard vials that contain solutions of boric acid / borax buffers coloured with hydrogen carbonate indicator. For example, browse to www.southernbiological.com and look for product codes SI21 and SI22.

SI21 – Set of 9 vials containing boric acid / borax buffers ranging in pH from 7.6 (yellow) to 9.2 (purple) in increments of 0.2 pH units. Compare your experimental vials to these standard solutions to estimate the pH.

Reference

To read more about using algal balls to study photosynthesis, go to:

www.saps.org.uk

and search for “algal balls” in the site’s search engine.