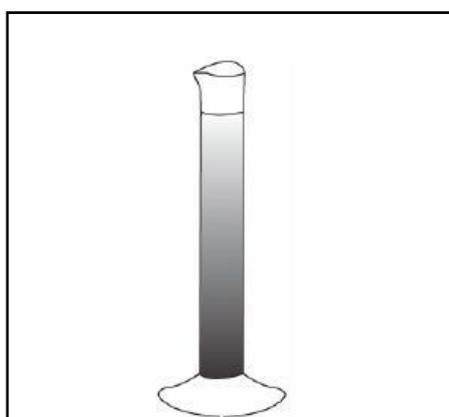


Photosynthesis... using algae wrapped in jelly balls

Algae can be considered as one-celled plants, and they usually live in water. You are going to use algae to look at the rate of photosynthesis. The algae are tiny and are difficult to work with directly in the water so the first part of the practical involves 'immobilising' the algae. This effectively traps large numbers of algal cells in 'jelly like' balls so that we can keep them in one place and not lose them. We use sodium alginate to help make the jelly. Sodium alginate is not harmful to the algae.

When these algae are 'wrapped up' in the jelly balls they are excellent to use in experiments on photosynthesis. These algal balls are:

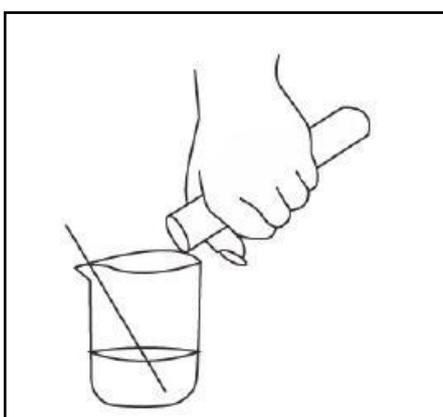
- cheap to grow and easy to make – you will be able to make hundreds in a very short time
- easy to get a standard quantity of plant material because each of the balls is approximately the same volume
- easy to keep alive for several weeks so you can keep them for future experiments



1. First you need to obtain a concentrated suspension of algae. Do this by removing some of the liquid medium in which they are growing in one of two ways.

Either Leave 50cm³ of dark green algal suspension to sediment out and gently pour off the supernatant to leave approximately 5cm³ at the bottom.

Or Place 50cm³ of dark green algal suspension in a centrifuge and spin gently for 5 minutes. Pour off the supernatant leaving approximately 5cm³.

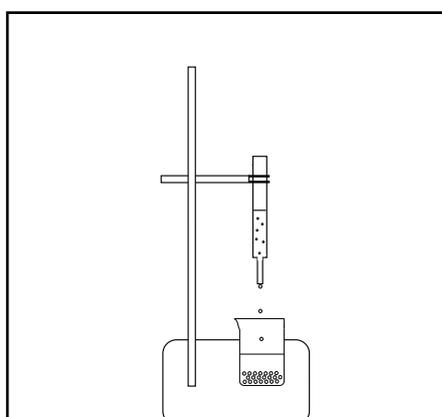


2. Now you have millions of algal cells in a small volume of liquid. It's time to mix them into your 'jelly'.

Pour about 2.5cm³ of jelly (sodium alginate solution) into a very small beaker.

Add approximately 5cm³ of concentrated algal cells.

Stir the mixture with a clean cocktail stick until you have an even distribution of algae in your jelly.



3. Finally we're going to make the balls...

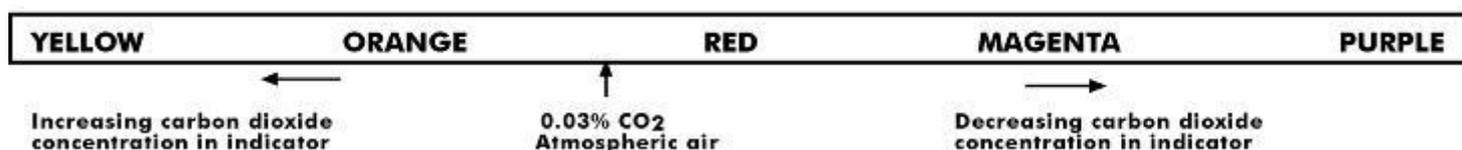
Pour the green mixture through an open-ended syringe into a 2% solution of calcium chloride.

Swirl the calcium chloride gently as the drops fall through the syringe to form small balls of algae.

Leave for 10-15 minutes in the calcium chloride and then wash the balls with distilled water. (A plastic tea strained is useful to separate the algal balls from the solution.)

When you have made your algal balls you can use them to determine the rate of carbon dioxide absorption - which indicates how fast photosynthesis is taking place. You can detect carbon dioxide absorption using hydrogencarbonate indicator.

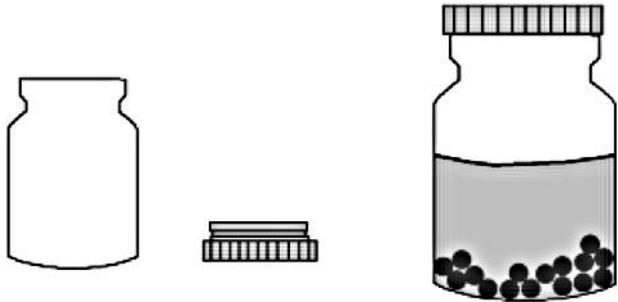
Hydrogencarbonate indicator is very sensitive to changes in carbon dioxide level. The indicator is orange/red in colour when equilibrated with atmospheric air. It changes to yellow when more carbon dioxide is added and changes through red to a deep purple colour when carbon dioxide is removed. The diagram below shows these colours.



Doing investigations with algal balls

When you place the algal balls in hydrogencarbonate indicator solution, the colour of the indicator changes from orange / red to purple. This is because the algae are taking carbon dioxide out of the indicator thereby lowering the concentration in the indicator as they use carbon dioxide in photosynthesis.

Here is an outline of how you could investigate the effect of light intensity on the rate of photosynthesis. You will need to decide on details of quantities and how to vary the light intensity.

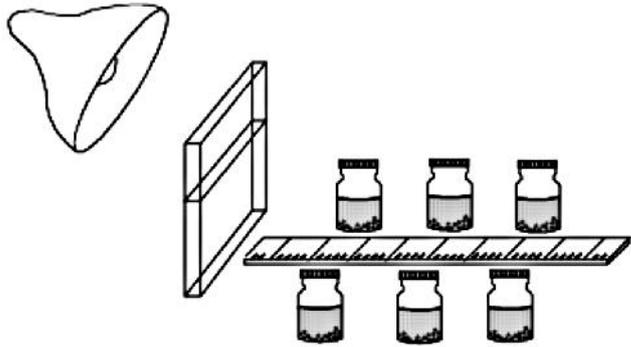


4. Take several small glass containers with lids and rinse all of them with a small volume of hydrogencarbonate indicators.

Add equal numbers of algal balls to each container.

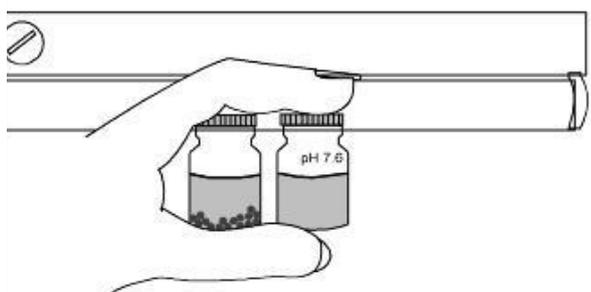
Add a standard volume of indicator to each container.

Replace the lid.



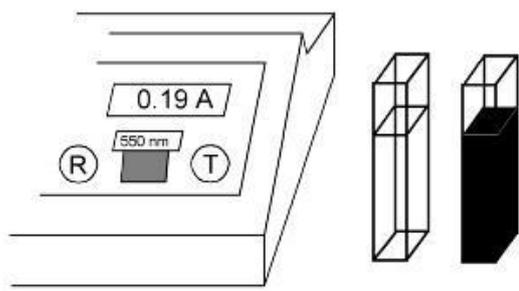
5. Place the containers at different light intensities.

Leave them until there is a visible colour change in some of the containers. (This may take 1-2 hours.)



Either 6a

Compare your colour changes with the standard buffer solutions. Hold each container to the light and match it to the buffer nearest in colour to your sample.



Or 6b Use a colorimeter to measure the absorbance of your solution

Fill a cuvette $\frac{3}{4}$ full with distilled water and place in the colorimeter. Press the zero or reset button.

Fill a second cuvette $\frac{3}{4}$ full with the indicator from one of our test solutions. Place in the colorimeter. Press the test button and take the reading.

Repeat with each of your test solutions.

A colorimeter can be used to measure the amount of light absorbed by the coloured solution. Different colours absorb different wavelengths of light to a different extent, so we shine light of a single wavelength through the mixture. It is best to use green light (wavelength 550 nm), because the colours of the indicator (purples, reds and yellows) absorb green light quite well.