ARC CENTRE OF EXCELLENCE FOR
translational
photosynthesis

Floating Leaf Disks for

Observing and Investigating Photosynthesis

Introduction:

This experiment is designed to show photosynthesis in action. More advanced students will be able to use the technique to answer their own questions about photosynthesis.

How it works:

Leaf disks float, normally. When the air spaces are replaced with water the overall density of the leaf disk increases and the disk sinks. The saturating solution should include a small amount of Sodium bicarbonate. Bicarbonate ion serves as the carbon source for photosynthesis.

As photosynthesis proceeds oxygen is released into the interior of the leaf which changes the buoyancy--causing the disks to rise. Since cellular respiration is taking place at the same time, consuming oxygen, the rate that the disks rise is an indirect measurement of the net rate of photosynthesis.

Materials:

1/8 teaspoon Sodium bicarbonate (Baking soda)

1 drop dishwashing liquid
300ml distilled or cooled, pre-boiled water
1 x liquid syringe (no needle required!)
Leaf material (3-4 leaves per experiment)
Hole punch or small cookie cutter
2 x plastic cups
Timer
Light source

Procedure:

Prepare bicarbonate solution for each trial by mixing:

1/8 teaspoon baking soda
300ml distilled or cooled, pre-boiled water
1 drop dishwashing liquid

The bicarbonate serves as a source of carbon dioxide for photosynthesis. The dishwashing liquid wets the hydrophobic surface of the leaf allowing the solution to be drawn into the leaf. It's difficult to quantify this since liquid soaps vary in concentration. Avoid suds. If your solution generates suds then dilute it with more water and bicarbonate solution.

Cut 10 or more uniform leaf disks for each trial.

Single hole punches work well for this. Plastic straws, small cookie cutters and fondant (icing) cutters will work as well.

Choice of the leaf material is perhaps the most critical aspect of this procedure. The leaf surface should be smooth and not too thick.

Avoid plants with hairy leaves. Ivy and fresh spinach both work well.

When you're cutting the disks, avoid major veins.

Infiltrate the leaf disks with sodium bicarbonate solution.

Remove the plunger of the syringe and place the leaf disks into the syringe barrel.

Replace the plunger being careful not to crush the leaf disks.

Push on the plunger until only a small volume of air and leaf disk remain in the barrel (< 10%).

Pull a small volume of sodium bicarbonate solution into the syringe. Tap the syringe to suspend the leaf disks in the solution.

Holding a finger over the syringe-opening, draw back on the plunger to create a vacuum. Hold this vacuum for about 10 seconds.

While holding the vacuum, swirl the leaf disks to suspend them in the solution. Let off the vacuum. The bicarbonate solution will infiltrate the air spaces in the leaf causing the disks to sink.

You will probably have to repeat this procedure 2-3 times in order to get the disks to sink. If you have difficulty getting your disks to sink after about 3 evacuations, it is usually because there is not enough soap in the solution. Add a few more drops of soap.

Pour the disks and solution into a clear plastic cup. Add bicarbonate solution. Use the same depth for each trial.

Place under the light source and start the timer.

At the end of each minute, record the number of floating disks.

Then swirl the disks to dislodge any that are stuck against the sides of the cups.

Continue until all of the disks are floating.

Extension investigations:

Once all the disks have floated to the top, place them in a dark cupboard. See how long it takes for them to sink.

Filter the light that the infiltrated disks receive using light filters or cellophane. See if there's a difference in the time it takes for them to float.