

Photosynthesis Lab

AP Biology - *Energy*

Background:

Photosynthesis is an anabolic process used by all photoautotrophs to capture light energy and convert it to store in the bonds of conveniently packaged molecules called sugars. What we'll be interested in doing in lab is measuring photosynthesis. This can be achieved in a variety of ways.

Although numerous intermediary reactions are involved, the **overall** photosynthetic reaction is simple: carbon dioxide combines with the hydrogen from water producing a carbohydrate – the six carbon sugar glucose – and oxygen gas.



The photosynthetic production of oxygen gas and introductory knowledge of leaf anatomy will allow for the construction of a simple system that can be used to experimentally investigate many potential photosynthetic variables. Many extracellular spaces exist within plant leaves that are normally filled with air for purposes of gas exchange. This is why leaves will float on the surface of bodies of water. But, what happens if we force all of the air out of the leaf? It would sink! That's useful.

If the requirements for photosynthesis are supplied, the leaf will produce oxygen gas which will make the leaf float. This gives us a way to measure photosynthesis. Here's how:

Small disks cut from leaves will be used instead of whole leaves to perform the **floating leaf disk assay (FLDA)**. This assay of photosynthesis can be used to answer tons of questions about photosynthesis are variables that may affect its rate.

One problem in measuring the rate of photosynthesis is that photosynthesis isn't the only metabolic process happening inside of plants. Remember that plants have mitochondria too, and aren't around solely for the chemoheterotrophs of the world. They consume their own sugars and undergo cellular respiration as well. As we've learned, cellular respiration uses the very product from photosynthesis we're trying to measure to determine its rate. So, the FLDA actually measures the rate of photosynthetic oxygen produced minus the rate of respiratory oxygen used during the same period. There's no way we can shut off cellular respiration in the leaf. So, we end up with a measurement of the **net rate** of photosynthesis, the energetic profit made by the plant. Actual photosynthetic activity is greater than this net rate and is called the **gross rate** of photosynthesis. If cellular respiration can be measured separately, a simple calculation can determine gross photosynthesis.

Materials:

Sodium bicarbonate (Baking soda)
Liquid soap
Plastic syringe (10 cc or larger)
Leaves
Hole punch

Plastic cups
Timer
Light source
Group specific materials for Part II

Floating Leaf Disk Assay (FLDA):

For this experiment, you will use the “Floating Leaf Disk Assay” for photosynthetic activity. A detailed protocol for this procedure is attached. Essentially, the assay follows the following steps:

1. Small disk sections of leaf tissue are punched from a leaf.
2. The disks are infiltrated with a bicarbonate solution. The infiltration serves two major purposes:
 - a. It increases the density of the leaf disks so that they sink
 - b. It supplies the disks with a carbon source (the bicarbonate ion) for the purpose of photosynthesis.
3. After infiltration, the disks are placed at the bottom of a container (we will use petri dishes) of the bicarbonate solution.
4. When exposed to light, the disks will produce Oxygen gas, decreasing their density to the point that they will float to the top of the container.
5. The time it takes for disks to float is directly related to the rate of photosynthetic activity taking place in the leaf disks.

Stuff to consider:

- The Need for A Control:
 - You wouldn't want to run an experiment without (at least one control). C'mon, rookie.
- Determination of the rate of Photosynthesis AND the Rate of Respiration:
 - The rate of respiration needs to be determined in order to calculate the rate of gross photosynthesis

Steps to complete before beginning your experiment:

- Develop a detailed procedure & clear experimental plan for your experiment.
- Develop a data table for your experiment.
- Determine any calculations that will be necessary for your data.
- Think about how you will graph your results (at least one graph is required for this lab).

After reviewing your procedures, **come see me**. I need to approve your protocol before you can conduct your experiment.

