

Carbon Cycle, Plants and Rising Temperatures

Carbon is never really lost or found, it is cycled through various reservoirs such as the atmosphere by plants and animals through respiration and photosynthesis (among other processes). We think of plants carrying out photosynthesis and animals carrying out respiration, but plants do both.

Photosynthesis: Sunlight (energy) + CO₂ + H₂O → O₂ + Sugar

Respiration: Sugar + O₂ → CO₂ + Energy + H₂O

In this lab, you will design and conduct a simple experiment to test one the following two questions:

- 1) Which process (photosynthesis or respiration) is more dominant for plants.
- 2) How does photosynthetic activity of aquatic plants change the chemistry of the water the plants live in.

You will design an experiment to test this.



Here are the available materials:

- Test tubes
- Test tube stoppers or parafilm
- Water
- Bromothymol blue (BTB)
- Aquatic plant
- Test tube rack
- Aluminum foil
- Straws
- Light source

Procedure:

1. Answer question #1.
2. With your group, design an experiment to test one of two ideas mentioned above.
3. You will have up to four test tubes and lids to work with. Make sure you have a control set up.
4. When you fill your test tubes, make sure they are all the way full. If possible don't leave any air in them.
5. Make a simple data table to fill in.

Questions:

1. Think about a plant and how it survives – what is the purpose of photosynthesis as far as the plant is concerned?

2. Which question is your group trying to answer?

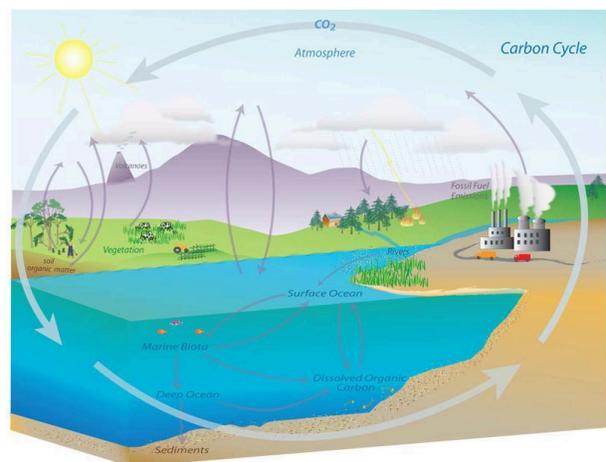
3. Explain why you set up the experiment the way you did.

4. Which test tube is the control?

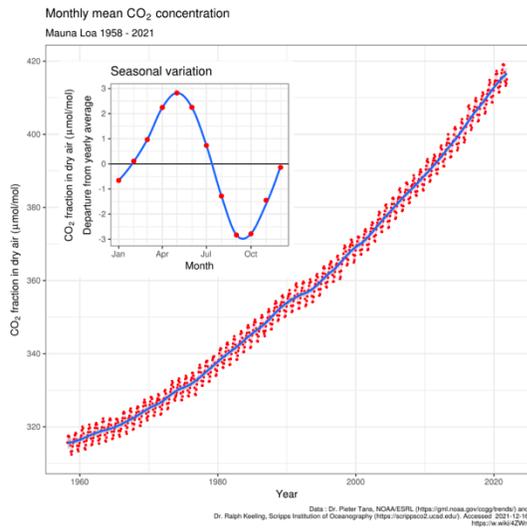
5. Which test tube(s) demonstrated photosynthesis?

6. Circle the part of the carbon cycle that is affected by what your experiment demonstrated.

Explain why you circled that part.

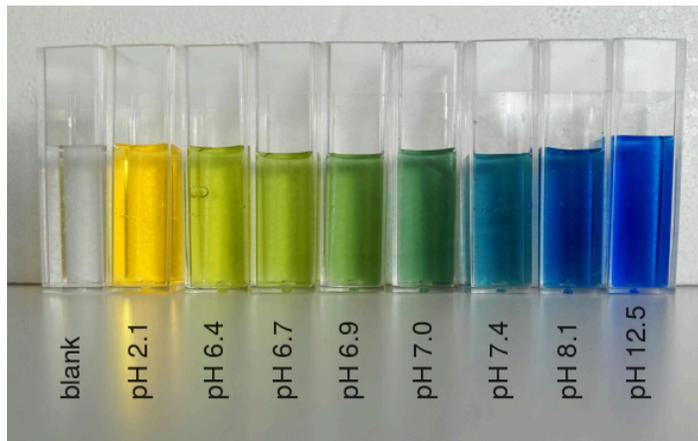


7. How does this lab help explain the red line in the graph and the trend in the enlarged part of the graph?



Teacher Notes:

Before doing this activity it is necessary to show how Bromothymol blue (BTB) works. BTB is an indicator solution which changes color depending on the pH of the solution. And since the addition of CO_2 to water makes it more acidic BTM can be a proxy for CO_2 . This is how it will be interpreted in this activity. Here is the color scale of this indicator solution.



More acidic
More CO_2  Less Acidic (more basic)
Less CO_2

First talk about what a proxy is. It is not a direct measurement of CO_2 but something that changes as the concentration of CO_2 does. Therefore, the color of the water mimics the changes in CO_2 .

Have a beaker with 150 mL of water and enough BTM to turn it blue.

Have a student do 20 jumping jacks, then have them blow through a straw. It will take about three breaths to change the pH of the water and change its color to yellow indicating the addition of CO_2 .

This activity highlights qualitative data and not quantitative data or conclusions. This experiment shows how the CO_2 concentration changes, but it does not address how much it has changed.

Some Possible Student Experiments:

1. To eliminate light some may put a flask in a cabinet or cover it with paper or aluminum foil.
2. Some may have some plants in yellow BTB and others in blue BTB (not helpful).
3. The best will involve a plant in yellow BTB in the light, a flask with only yellow BTB in the light, and a plant with yellow BTB in the dark.

Answer to question 1: The purpose of photosynthesis is to make organic molecules (sugars). It is VERY important to keep students from concluding that photosynthesis evolved to produce oxygen. Oxygen gas is a waste product of the process that organisms then adapted to using.