The effects of Light Intensity on the Rate of Photosynthesis of Aquatic Plants

Purpose

Using "Borderless Lab 365", to investigate the effect of light intensities (dark and light) on aquatic plants' rate of photosynthesis.

Theory

- **Photosynthesis process:** Aquatic plants carry out photosynthesis during daytime and respiration during night time. Photosynthesis is the process where plants absorb carbon dioxide and release oxygen while respiration is the process where plants absorb oxygen and release carbon dioxide. Photosynthesis depends on light since the energy from light is used to break down carbon dioxide and water molecules for further reorganization into glucose sugar and oxygen gas. The dynamic balance of the amounts of oxygen and carbon dioxide is determined by the intensity of photosynthesis and respiration of aquatic plants.

- **Marimo:** The aquatic plant used in this experiment is Marimo, a special growth form of Aegagropila linnaei, which is also called or moss ball. Marimo is a ball-shaped green algea union and is used to water of temperature around 22 ^{O}C. Since Marimo is a kind of aquatic plant, the production of gases would be seen and collected in the tubes in water. Gas detectors are used for further analysis after collection.

Materials

- "Borderless Lab 365" Platform
- An aluminim frame covered by dark cardboard
- Plenty aquatic plants (Marimo, also called the moss ball)
- Funnels and test chamber (with Oxygen and Carbon Dioxide gas sensors)
- White LED light sources

Procedure

Set up the experiment

1. Place the aquatic plants in the water for a few days.
2. Use a funnel to cover the upper top of the Marimo and use a rubber catheter to connect with the thinner end of the funnel.
3. Put the sensor around the other end of the rubber catheter within a sealed box.

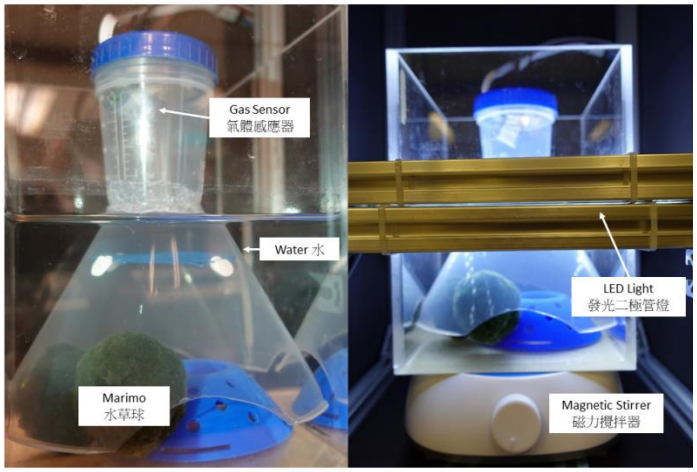

Figure 1. Experimental setup

Start the experiment

4. Log in the experiment module “Photosynthesis” on the Borderless Lab 365 platform. https://stem-ap.polyu.edu.hk/remotelab/

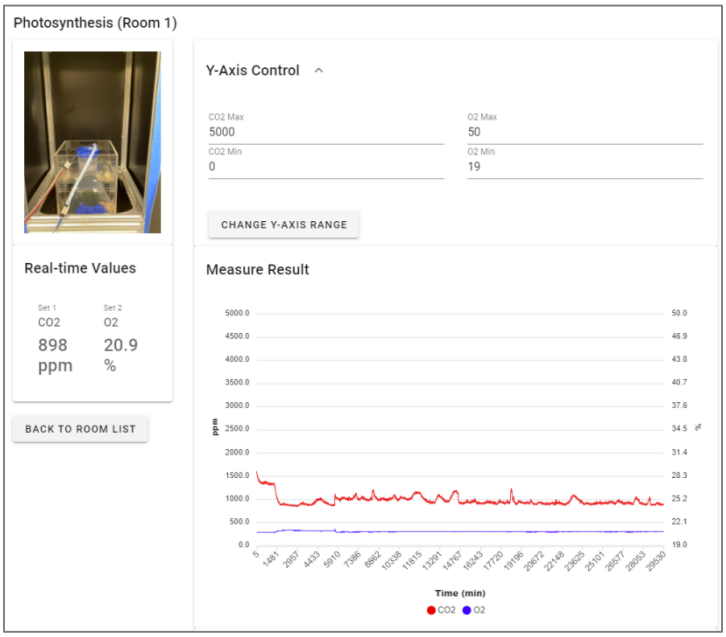

Figure 2. User interface of experiment

5. Turn on the sensor and let it run for 5 minutes until the reading is stable. Save the data of primary concentration of oxygen and carbon dioxide in the water.
6. Turn off the lights and cultivate Marimo in water for 12 hours.
7. Turn on the lights and cultivate Marimo in water for 12 hours.
8. Observe and save the recorded data of the gas sensors.
9. Press “LOGOUT” on the left when you complete the experiment.

Results

1. Get the data from the gas sensor.

Oxygen level at	Dark	Light
Initial		
5 min		
10 min		
15 min		
……		

Carbon Dioxide level at	Dark	Light
Initial		
5 min		
10 min		
15 min		
……		

2. Plot the graph of Oxygen level against time.
3. Plot the graph of Carbon Dioxide level against time.
4. Calculate the carbon dioxide uptake for each light intensity.

*Website below explains how to calculate the light intensity after plotting the graph for reference.
https://www.bbc.co.uk/bitesize/guides/z9pjrwx/revision/5#:~:text=in%20grape%20vines-,Light%20intensity,factor%20%2D%20becomes%20in%20short%20supply.

Discussion

1. Describe the results when the lights were turned off and on, why?

2. According to the plot you draw, at what time does the photosynthesis rate catch up with the respiration rate?

3. At the time when the photosynthesis rate catches up with the respiration rate, according to the formula:

$$6CO_2+6H_2O \text{ (light, chlorophyll)} \rightarrow C_6H_{12}O_6\text{(Glucose)}+6O_2$$

   How many moles of glucose is generated?