12. PHOTOSYNTHESIS OF AQUATIC PLANTS

How do darkness, ambient light, and bright light affect the amount of oxygen produced by an aquatic plant through photosynthesis?

Objectives

- Compare the impact of different light levels on the rate of photosynthesis in aquatic plants.
- Describe the role of aquatic plants in the carbon cycle and in the cycling of energy.

Materials and Equipment

- Data collection system
- Optical dissolved oxygen sensor
- Photosynthesis tank or similar setup
- Magnetic stirrer with magnetic stir bar
- Lamp with CFL or LED 100-W equivalent bulb
- Heavy cloth, 50 cm × 50 cm
- Leafy aquatic plant such as *Elodea* sp. or hornwort, several sprigs in dechlorinated water

Safety

Follow regular lab safety procedures.

Procedure

1. Select Sensor Data in SPARKvue.
2. Connect the dissolved oxygen (DO_2) sensor to your device.
3. Make sure only the DO_2 Concentration measurement from the dissolved oxygen sensor is checked. Choose the Graph template.
4. Completely fill the inner chamber of the photosynthesis tank with tap water.
5. Add several large, healthy sprigs of the aquatic plant to the inner chamber. Add a stir bar to the inner chamber.
6. Remove the rubber cap from the DO_2 probe. Avoid touching the bottom of the probe. Tighten the metal cap at the end of the probe if necessary.
7. Plug the small hole in the large stopper and seal the inner chamber with the stopper as shown in Figure 1. Water from the inner chamber will overflow when the stopper is placed on the tank. Follow your instructor's directions if not using a photosynthesis tank.
8. Set the photosynthesis tank on the magnetic stirrer. Seal the stopper with the DO_2 sensor. Add enough tap water to the outer chamber to meet the inner chamber water level as shown in Figure 1.

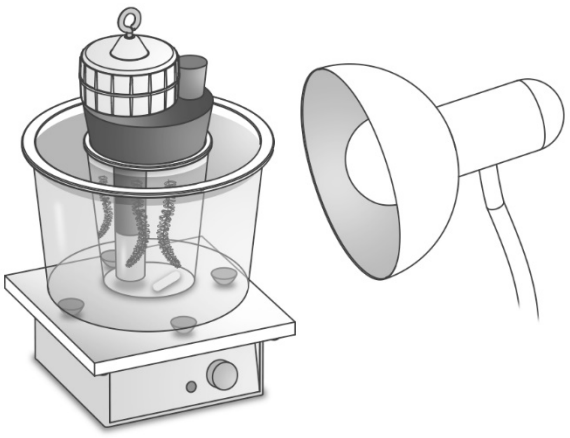

Figure 1: Photosynthesis tank setup

9. Make sure the metal portion of the DO_2 probe is fully submerged, the end of the probe is about 1 cm above the stir bar, no plant material is touching the bottom of the probe, and no air bubbles are trapped on the bottom of the probe.

10. Without turning on the lamp, position the bulb near the photosynthesis tank so the light will shine directly on the aquatic plant as shown in Figure 1.

11. Turn on the magnetic stirrer to a medium speed.

12. Select Start to begin collecting data. Record the initial DO_2 Concentration for ambient light in Table 1.

13. Stop collecting data after about 5 minutes. Record the final DO_2 Concentration and time elapsed in Table 1.

14. Turn on the lamp and start collecting data. Record the initial DO_2 Concentration for bright light in Table 1.

15. Stop collecting data after about 20 minutes. Record the final DO_2 Concentration and time elapsed in Table 1.

16. Turn the lamp off. Cover the photosynthesis tank with a heavy cloth so the entire system is in complete darkness. Start collecting data and record the initial DO_2 Concentration for darkness in Table 1.

17. Stop collecting data after about 15 minutes. Record the final DO_2 Concentration and time elapsed in Table 1.

18. Rinse the DO_2 sensor with water and replace the rubber cap.

19. Calculate the change in DO_2 Concentration according to the following equation and record the result in Table 1.

    Change in DO_2 Concentration = Final DO_2 Concentration - Initial DO_2 Concentration

20. Use the following equation to calculate the rate of DO_2 Concentration change and record the result in Table 1.

    Rate of DO_2 Concentration Change = Change in DO_2 Concentration ÷ Time

Data Collection

Table 1: Change in DO_2 under different light conditions

Light Condition	Initial DO_2 Concentration (mg/L)	Final DO_2 Concentration (mg/L)	Time (s)	Change in DO_2 Concentration (mg/L)	Rate of DO_2 Concentration Change ($mg/L \cdot s^{-1}$)
Ambient light					
Bright light					
Darkness					

Questions and Analysis

1. Explain what happens to the rate of photosynthesis in aquatic plants under different light conditions. Support your answer with data from this investigation.

2. Use the setup in this investigation to explain what is meant by a *closed system* and explain why it was important to perform this investigation within a closed system.

3. Plants are often referred to as *producers*, including land plants and aquatic plants. What would happen to consumers if the aquatic producer population was inhibited? Give an example of an event that may cause aquatic producers to be unable to perform photosynthesis.

4. Explain how aquatic plants play a role in the flow of energy and carbon through aquatic ecosystems. Include observations made during this investigation to support your answer.