Instructor Information

Photosynthesis and Cellular Respiration in Aquatic Plants

1. Different styles of dissolved oxygen probes can be used for this experiment: Dissolved Oxygen Probes and Optical DO Probes. This experiment is written for the Optical Dissolved Oxygen Probe.
2. Aquatic mosses are available at many pet stores that sell fish tank supplies. They are also available from mail order suppliers.
3. For best results, the aquatic moss should be placed into fresh water upon arrival and kept at room temperature under a plant light or in a sunny window.
4. To prepare aged tap water, fill a bottle or pitcher with tap water at least 12 hours before class and allow it to sit open at room temperature. This allows excess oxygen to diffuse out of the water prior to the experiment.
5. The type of light bulb is very important for this experiment.

We recommend 12 W LED grow lights; they give the best results because they provide the correct wavelengths for photosynthesis and produce minimal heat energy.

35 W halogen, flood-beam bulbs or standard 100 W incandescent bulbs can work. However, both bulbs radiate a lot of heat energy, which can affect the results.

For more information see [**www.vernier.com/til/1519**](http://www.vernier.com/til/1519)

1. A heat sink is recommended to mitigate temperature changes what type of light source you use. A 600 mL beaker can be used but a tissue culture flask filled with water makes a good heat sink because it is thinner, and will allow the plant to receive much more light from the same lamp than a beaker.
2. It is possible to substitute green algae cultures for aquatic moss in this lab preparation with a few changes. If using marimo algae balls (a naturally occurring colony of Aegagropila linnaei), allow for 30 minutes of data collection with a 5 minute acclimation time prior to starting data collection. If using Bio-Rad algae beads, we recommend placing them in a smaller volume container such as a 50 mL flat-bottomed digestion tube, and using a small stir bar. The digestion tube can be placed inside an erlenmeyer flask to prevent tipping over. The waiting time before starting data collection may need to be lengthened depending on the rate of gas production. You may wish to monitor the gas concentrations and start collecting data when the levels of gas begin to move in the correct direction. It may take up to 30  minutes under some conditions.
3. If you are using Go Direct sensors, see [**www.vernier.com/start/go-direct**](http://www.vernier.com/start/go-direct) for information about how to connect your sensor.
4. For additional information about the Vernier probeware used in this experiment, including tips and product specifications, visit [**www.vernier.com/manuals**](http://www.vernier.com/manuals) and download the appropriate user manual.

ESTIMATED TIME

We estimate that setup and data collection can be completed in one 45-minute class period if using aquatic moss, and in one 90 minute class period if using algae.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

| Disciplinary Core Ideas | Crosscutting Concepts | Science and Engineering Practices |
| --- | --- | --- |
| LS1.A: Structure and FunctionLS1.C: Organization for Matter and Energy Flow in OrganismsLS2.B: Cycles of Matter and Energy Transfer in Ecosystems | Cause and EffectStructure and Function Energy and MatterSystems and System Models | Analyzing and Interpreting DataDeveloping and Using Models |

SAMPLE RESULTS

|  |  |
| --- | --- |
| Aquatic Moss | Rate of respiration/photosynthesis(DO mg/L/min) |
| In the dark | –0.00879 |
| In the light | 0.01762 |

ANSWERS TO QUESTIONS

1. The DO rate value for aquatic plants in the dark was a negative number. The biological significance of this is that O2 is consumed during cellular respiration. This causes the concentration of DO in the water to decrease as glucose is oxidized for energy.
2. The DO rate for aquatic plants in the light was a positive number. The biological significance of this is that O2 is produced during photosynthesis. This causes the concentration of DO in the water to increase.
3. Yes, cellular respiration occurred in aquatic plants, since DO decreased when plants were in the dark and photosynthesis was not possible.
4. Yes, photosynthesis occurred in aquatic plants, since DO increased when plants were exposed to light.
5. Answers may vary. They might include:
	* An amount of plants should increase the rate in both the light and dark treatments, since there are more chloroplasts to undergo photosynthesis and more cells to require energy through cellular respiration.
	* A greater light intensity will increase the rate of photosynthesis. It may not affect the rate of cellular respiration, however.
	* Cooler water may decrease both rates, as cellular metabolism decreases in cooler weather.
	* Hot water may decrease both rates, as proteins involved with photosynthesis and cellular respiration may not function if overheated.
	* Blocking certain wavelengths of light may alter photosynthetic rates.