

# Photosynthesis and Cellular Respiration Rates in Plants Using Vernier Probes

**Time: 55 minutes**

**Grade level: 9-12**

## Objectives:

- Students will be able to use CO<sub>2</sub> Gas Sensors to measure the amount of carbon dioxide consumed or produced by a plant during respiration and photosynthesis.
- Students will be able to determine the rate of respiration and photosynthesis of a plant.

## Idaho Achievement Standards:

- 649.01c Use technology and mathematics to improve investigations (data collection and analysis) and communication.
- 652.02a Know that atoms and molecules cycle among the living and nonliving components of the biosphere.
- 652.02b Trace energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.
- 653.01b Know that living systems require a continuous input of energy to maintain their chemical and physical organization.
- 653.01c Know that the energy for life is primarily derived from the sun through photosynthesis.
- 653.01d Understand cellular respiration and the synthesis of macromolecules.
- 653.01e Know that chemical bonds of food molecules contain food energy, which is released when the bonds are broken.
- 653.01h Trace how matter cycles and energy flows through different levels of organization of living systems – cells, organs, organisms, communities – and between living systems and the physical environment.

## Materials:

- |  |                                       |                            |
|--|---------------------------------------|----------------------------|
| ▪ Living leaf samples from different types of plants | ▪ Vernier CO <sub>2</sub> Gas Sensors | ▪ Forceps                  |
| ▪ Computers loaded with Logger Pro software          | ▪ 250-mL conical flasks               | ▪ Tape                     |
| ▪ Vernier computer interface                         | ▪ Lamps                               | ▪ Scissors                 |
|  | ▪ Colored cellophane                  | ▪ Paper towels             |
|  | ▪ Ice bath                            | ▪ Colored chalk            |
|  | ▪ Aluminum foil                       | ▪ 500 mL beaker with water |

## Procedure:

- I will engage the students through quickly explaining that they will be conducting experiments on plant leaves to determine the rate of consumption or production of CO<sub>2</sub> using gas sensors. (Time 3 min.)
- I will have the students get into groups of 2-3, come to the materials table and pick up the “Procedures Paper”, “Data Collection/Answer Sheet”, their “Take Home Assignment”, leaf sample (of choice), and 250 mL flask. and let them choose the plant material they wish to work with. (Time 2-3 min.)

- I will demonstrate for the students how to set up experiment; (putting leaf into flask, sensor into flask, and starting data collection with computer) and have them get started. (Time 1-2 min.)
- As students start their experiments I will ask them questions concerning photosynthesis and respiration allowing them to answer and then explain the chemical equation to the students of what happens during photosynthesis and respiration. (Time 3-5 min.)
- During the experiments I will move from group to group asking them questions and answering their questions about their experiments, what they notice happening with the data collection, and their predictions. (Time 25-30 min.)
- When both experiments are over each group (one group at a time), will graph their results from the data they collected on a chalkboard graph prepared for their data. Students may start another experiment if time allows. (Time 3-5 min.)
- I will have students present their findings to the rest of the class by discussing their predictions and results. (Time 3-5 min.)
- As a class we will discuss the chalkboard graph by comparing data from each experiment to other data sets. We will look for similarities and differences and discuss possible reasons for their existence. (Time 3-5 min.)

**Assessment:**

- I will conduct an oral assessment to determine what the students know about photosynthesis and cellular respiration.
- I will hand out a data collection sheet that will allow students to make predictions and complete information pertinent to graphing and data comparisons.
- During the lab I will move from group to group asking questions and discussing what the students are observing.
- At the end of the experiments I will have students explain their findings and I will have an open discussion with the class about similarities and differences among the experiments.
- Students will complete a formal assessment and turn it in the following week with their data collection sheets.