Measurements of Photosynthesis Rate in the Water Plant - Elodea Ernstiae

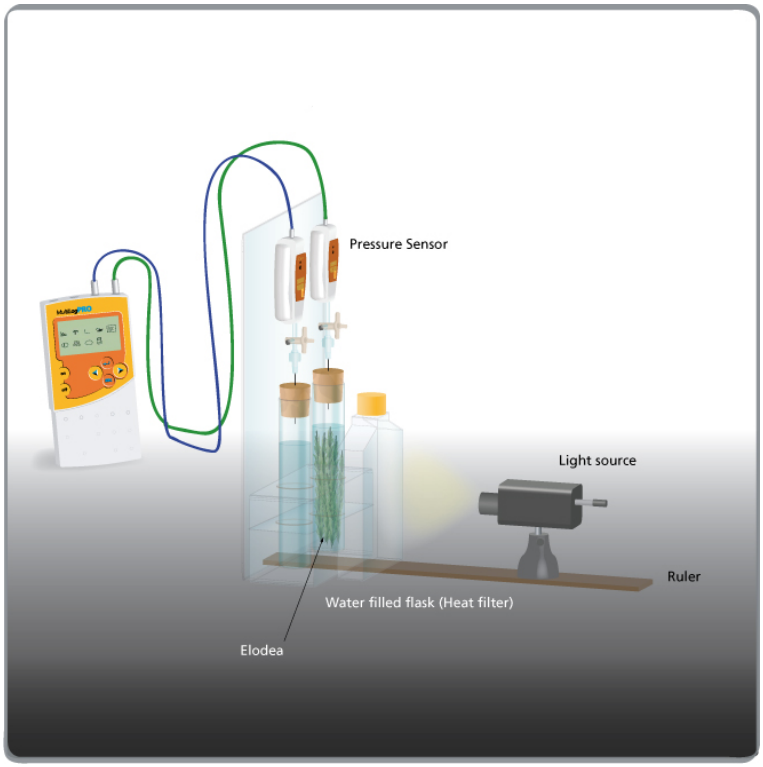


Figure 1

Introduction

Photosynthesis is the fundamental process whereby organic materials, carbohydrates, are produced from inorganic materials: carbon dioxide and water. In this process molecular oxygen is released. Light, absorbed by pigments of photosynthetic organisms, like for example, chlorophyll in green plants, is the energy source for this process.

Under optimal conditions of light intensity, carbon dioxide concentrations and temperature, photosynthesis rate depends on the surface area or mass of the plant exposed to light.

In this experiment, we follow the photosynthesis rate in Elodea by measuring the rate of oxygen release, using pressure sensors.

Equipment

- MultiLogPRO or Nova or TriLink data logger
- Photosynthesis kit (available from Fourier-Systems):
    - 50ml glass tube with rubber cork (2)
    - Needle no 23 (2)
    - Three way valve (2)
    - Latex tube
    - Perspex stand to support the tubes and sensors
    - 600mL flat plastic bottle (heat filter)
    - Pressure sensor (150 –1150mb) (2)
- 2 gr. of fresh Elodea
- Bright light source (e.g. 50W Halogen lamp)

Equipment Setup Procedure

1. Assemble the equipment as shown in Figure 1

a. Fill each glass tube with 0.5% bicarbonate solution. Leave a small volume of air between the solution surface and the cork

b. Slice the Elodea branch to segments that fit the tube size.

c. Dip the Elodea segments into one tube. The other tube will serve as the experiment control

d. Seal the tubes tightly with the rubber corks

e. Insert a syringe needle (no 23) through each cork, until its tip comes out of the cork (see figure 2)

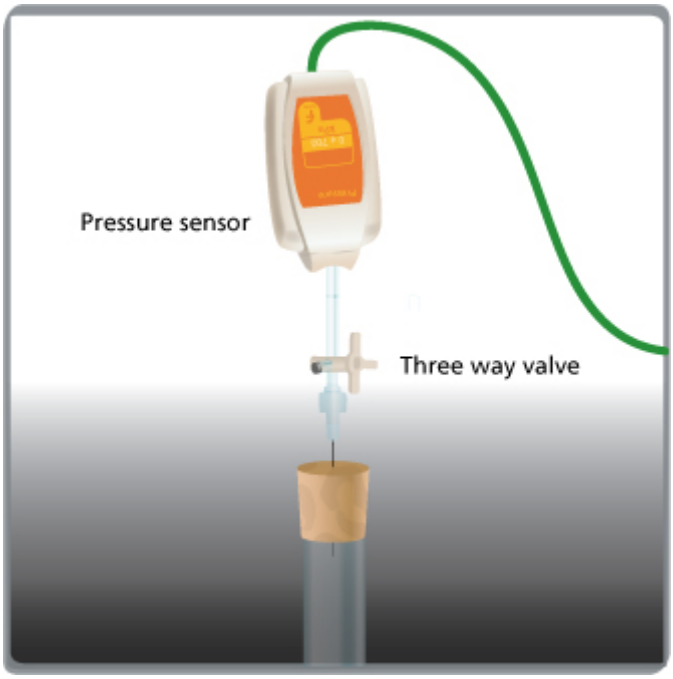


Figure 2

f. Connect each syringe needle to a three way valve with a short piece of latex tube (see figure 2)

g. Connect each valve to a pressure sensor (see figure 2)

h. Position the light source 25 cm from the glass tubes (see figure 1)

i. Fill the flat plastic bottle with water and place it between the light source and test tubes. The water block the heat that radiates from the light source

2. Turn on the data logger

3. Connect one pressure sensor to input 1 (I/O-1) of the data logger

4. Connect the second pressure sensor to input 2 (I/O-2) of the data logger

5. Connect the data logger to the computer

6. Run MultiLab

7. Click **Setup Wizard** on the main toolbar and **program** the data logger according to the setup specified below

Data Logger Setup

Sensors:

Input 1: Pressure (150 –1150mb)

Input 2: Pressure (150 –1150mb)

Rate:

Every second

Recording time:

01:23:20 HH:MM:SS (5000 Samples)

Experimental Procedure

Checking the experiment setup

Before starting the experiment make sure that the test tubes are tightly sealed:

1. Click **Run** on the upper toolbar to begin recording data
2. Turn the three way valves to enable free air flow from the surroundings (Position A – see figure 3). The readings should indicate now the atmospheric pressure

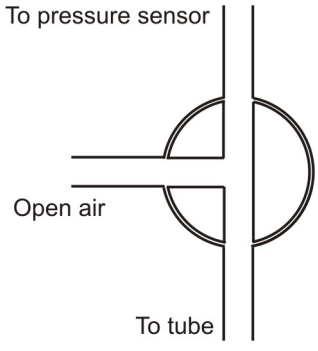


Figure 3: Three way valve – Position A

3. Turn the three way valves to seal the system from the surroundings (Position B – see figure 4)

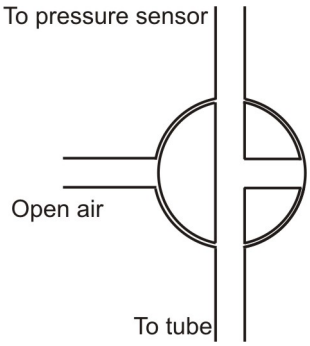


Figure 4: Three way valve – Position B

4. Press the corks. The pressure should rise a little and remain constant (see figure 5)

Figure 5

If the pressure drops (see figure 6) it means that there is an air leakage. Repeat step 4. If that doesn't help, replace the cork. The test tubes must be tightly sealed to be able to observe the phenomenon.

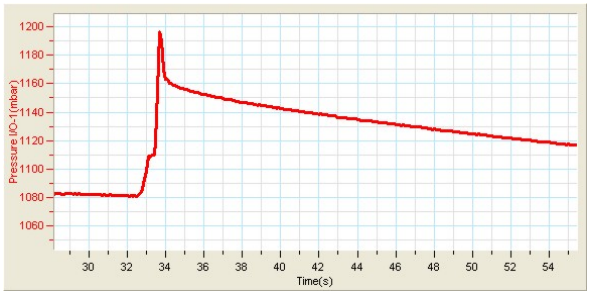


Figure 6

5. After you are satisfied that the test tubes are sealed click **Stop**  on the upper toolbar to stop collecting data

Performing the experiment

1. Reset the apparatus: turn the three way valves to position A, and then return to position B (see figures 3 and 4). The pressure in the tubes should now equal the atmospheric pressure
2. Turn on the light source
3. Click **Run**  on the upper toolbar to begin recording data
4. Monitor the photosynthesis rate until the pressure in the tube with the Elodea reaches about 1100mbar
5. Click **Stop**  on the upper toolbar to stop collecting data
6. Save your data by clicking **Save**  on the upper toolbar

Data Analysis

1. To calculate the net reaction rate, create a difference graph: subtract the graph obtained in the control system from that of the experimental system:

a. Click Analysis **Wizard**  on the main toolbar, then click the **Functions** tab

b. In the **Functions** drop list select **Subtract**

c. In the **G1** drop list select Pressure I/O-1, In the **G2** drop list select Pressure I/O-2

d. In the **Name** edit box enter a name (e.g. Difference)

e. Click **OK**

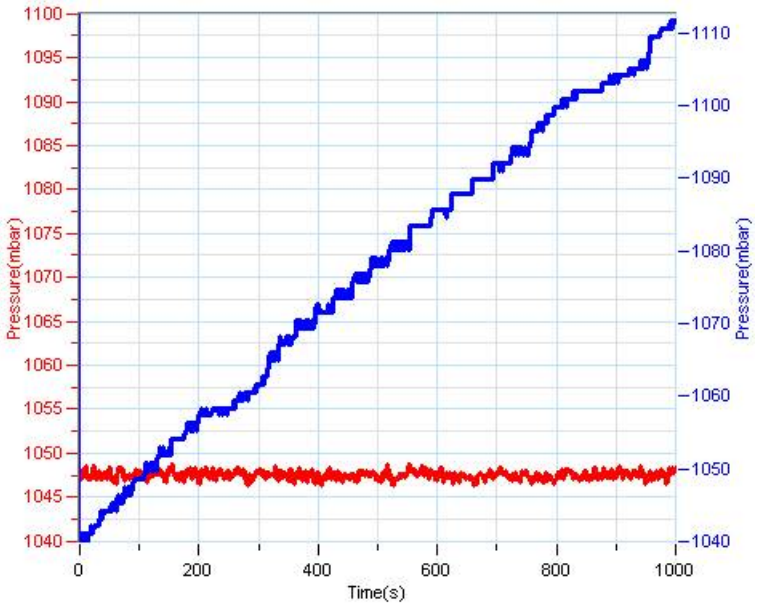
2. Apply a linear fit to the difference graph:

a. Use the cursors to select the desired range

b. Click **Linear fit** on the main toolbar. The fit equation will be displayed in the information bar at the bottom of the graph window

c. The slope of the fit line is the net reaction rate

An example of the graph, obtained in this experiment, is shown below:



In the following graph, the difference graph and calculated slope are shown: