ScienceCube

Oxygen in Plants

Learning Objectives

Investigating the Effect of Sunlight on Plants and Explaining Changes in Oxygen Levels.

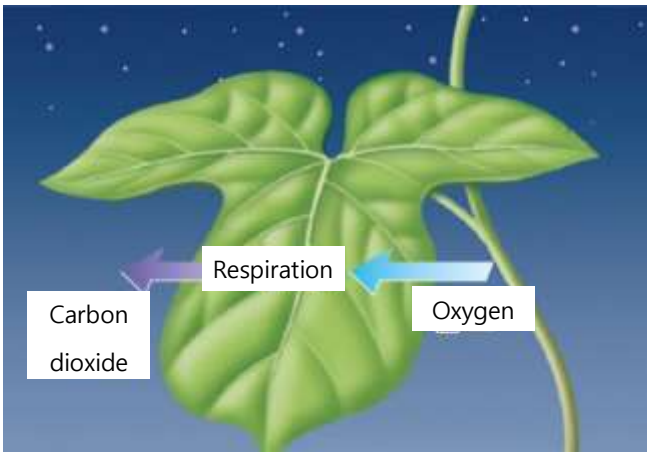
Should I think about it?

How does the amount of oxygen change when light is shined on plants?

Learning Content

1. Plant Respiration

Plants, like animals, need to breathe to survive. Plants take in oxygen and release carbon dioxide just like animals do. Although plants may appear not to breathe during the day because they perform photosynthesis, absorbing carbon dioxide and releasing oxygen, they are actually breathing day and night.

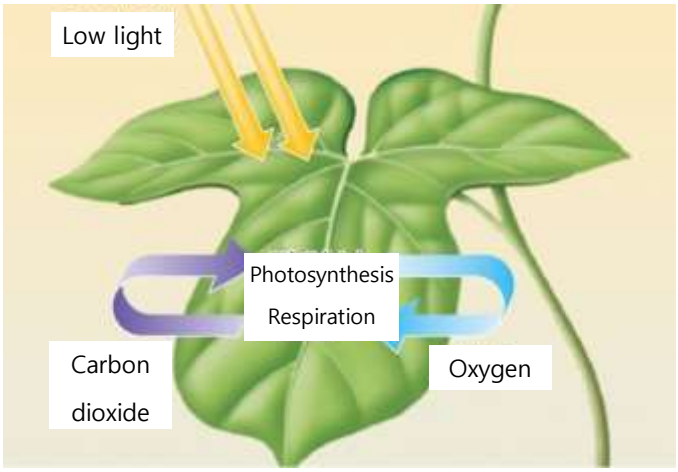


2. Plant Photosynthesis

The process of photosynthesis in green plants involves using light energy to produce organic substances like glucose from water absorbed by the roots and carbon dioxide absorbed through the stomata in the leaves, with oxygen as a byproduct. This process can be represented by the following equation.

Water + Carbon Dioxide (+Light Energy)

→ Glucose + Oxygen



Plants use the organic nutrients produced by photosynthesis to build their bodies, produce energy for living, and serve as food for animals. Animals consume these organic substances through the food chain, using them to build their bodies or breaking them down through respiration to produce the energy needed for living. Ultimately, all life on Earth depends on photosynthesis.

3. Photosynthesis and Respiration

1) Daytime: Photosynthesis > Respiration → Absorbing carbon dioxide, releasing oxygen

   The amount of photosynthesis exceeds respiration, so carbon dioxide needed for photosynthesis is absorbed, and oxygen produced by photosynthesis is released.

2) Morning and Evening: Photosynthesis = Respiration → No visible gas exchange

   The amount of photosynthesis and respiration is equal, so all the oxygen produced by photosynthesis is used in respiration, and all the carbon dioxide produced by respiration is used in photosynthesis.

3) Night: Only Respiration → Absorbing oxygen, releasing carbon dioxide

Without light, photosynthesis does not occur, so only respiration happens, absorbing the oxygen needed for respiration and releasing the carbon dioxide produced by it.

4. Oxygen Sensor

- The oxygen sensor contains electrodes immersed in an electrolyte solution, where an electrochemical reduction occurs when oxygen molecules enter. This sensor can become inaccurate after prolonged use (about two years).
- The oxygen sensor should be placed in a well-ventilated atmosphere and allowed to stabilize before calibrating the oxygen concentration to 20.9% using the dedicated program.
- The concentration of oxygen in the air changes with the amount of water vapor, so to calibrate the oxygen sensor accurately, the relative humidity of the current space should be taken into account.

Relative Humidity	0%	25%	50%	75%	100%
Oxygen Concentration by Volume (%)	20.9	20.7	20.5	20.3	20.1

Experimental Activities

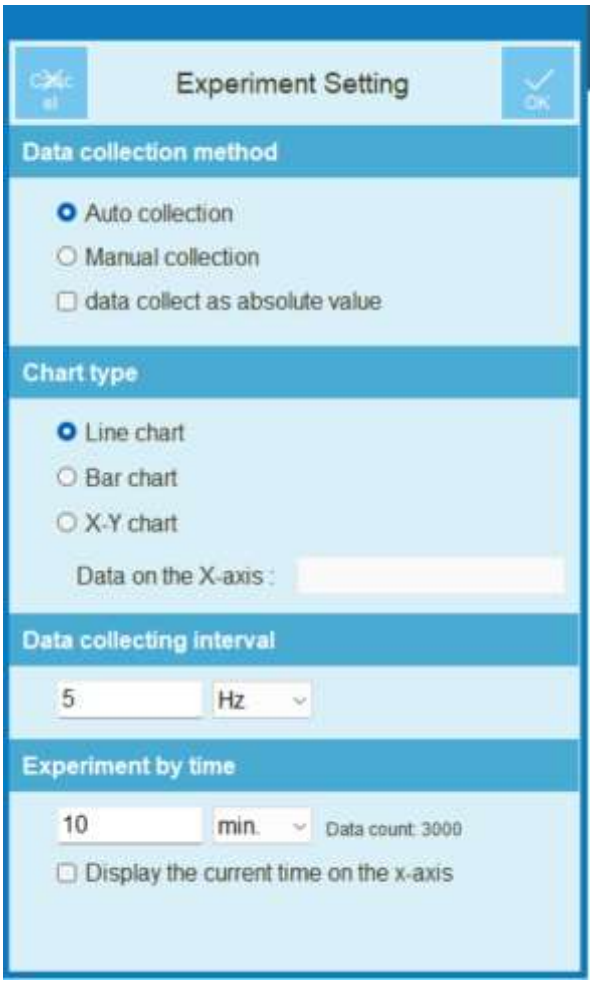
Materials Needed

Interface, Science# program (smart device), Oxygen sensor, Fish tank with a lid, Plant, Stand

Experiment Procedure

Setting up the Equipment

1. Run the Science# program on the smart device and connect it to the powered-on interface via Bluetooth or cable.
2. Connect the oxygen sensor to the interface.
3. Press the button  in Science# to set up the experimental environment as shown below (automatic setup available).



Calibrating the Oxygen Sensor

1. Move the oxygen sensor to a well-ventilated area and wait until it stabilizes.

2. Press the button  and perform the [Factory Reset] - [1P] calibration as shown below.

   * It is recommended to factory reset and perform 1P calibration in normal oxygen concentration air to ensure the sensor functions correctly after long-term storage.

Conducting the Experiment

3. Place a potted plant inside the fish tank.

4. Place the interface with the oxygen sensor inside the fish tank.

5. Cover the fish tank with the lid.

6. Place the stand about 10-20 cm away from the fish tank.
7. Press the button, turn on the stand light, and measure the change in oxygen levels inside the fish tank.

8. The experiment will end automatically after the preset time.

Experimental contents

1. Graph the changes in oxygen levels over time when light is shined on the plant.

2. Record the initial oxygen level and the oxygen level after 5 minutes.

Category	Initial oxygen level	After 5 minutes
Amount of oxygen (%)		

Experimental results

1. Explain what changes occur when the plant receives sunlight based on the experimental results.

2. Write down the activity where plants produce nutrients like starch when exposed to light.


Report
(For Teachers)
Report
(For Students)