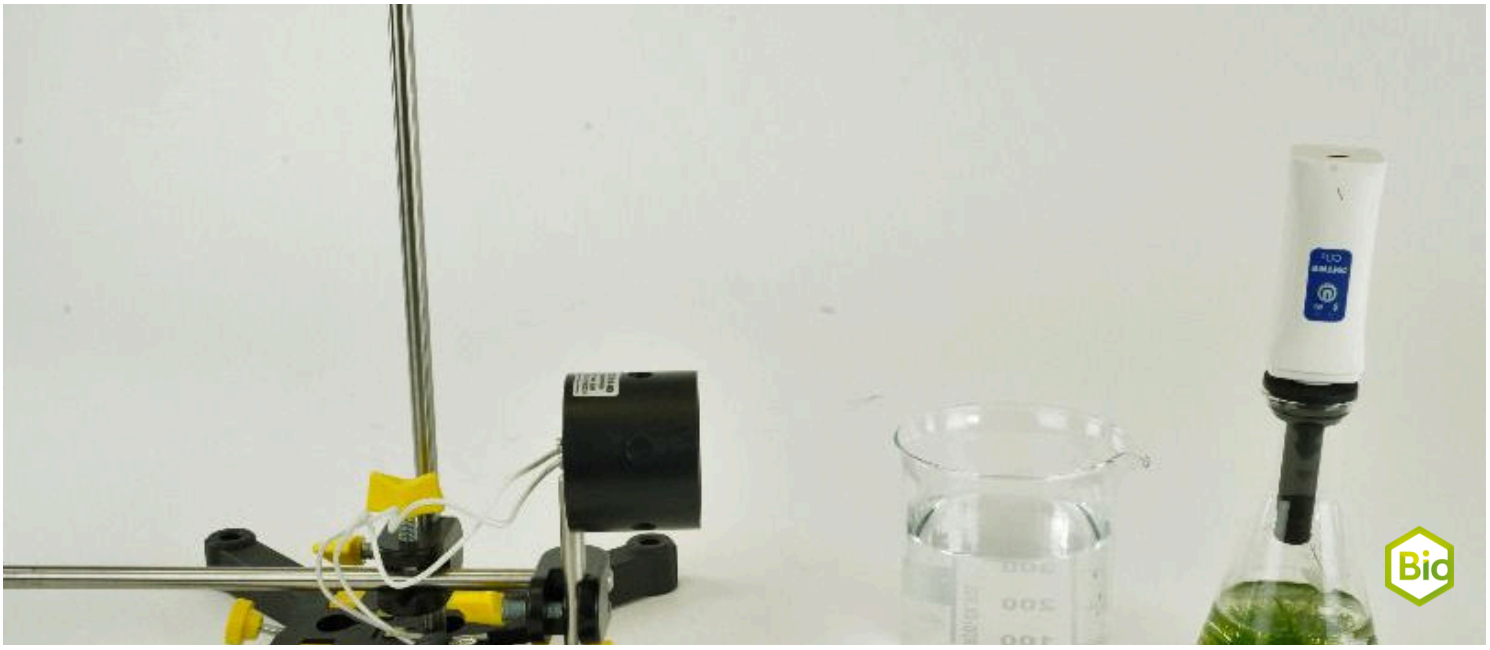
Respiration of plants with Cobra SMARTsense



Biology | Plant Physiology / Botany | Germination, growth, development

Difficulty level	Group size	Preparation time	Execution time
medium	-	20 minutes	30 minutes

This content can also be found online at:

http://localhost:1337/c/62ebbc267956f200031811ca

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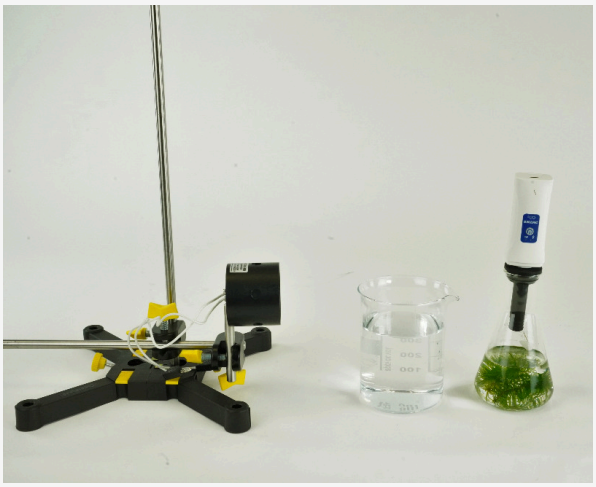
General information

Application



Experimental setup

This experiment shows that carbon dioxide is absorbed by plants when illuminated. The carbon dioxide concentration and its change in a closed container is measured. This experiment allows a quantitative measurement under different environmental conditions.

An aquatic plant is used because land plants wilt quickly under unfavourable light and temperature conditions, which affects the measurement.

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Application

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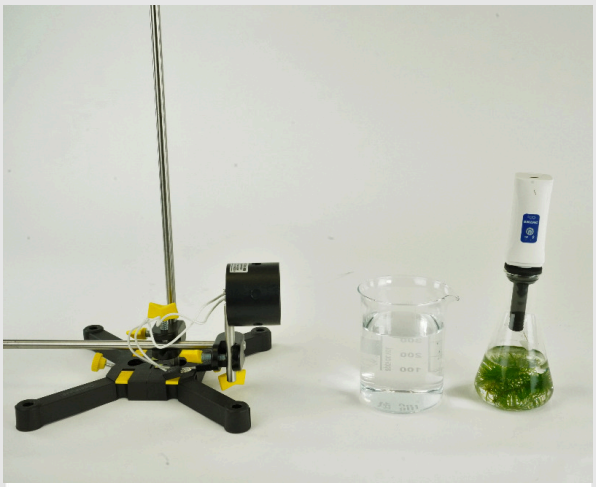

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Other information (1/3)

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Prior knowledge

Students should be familiar with the basic biological and chemical principle of photosynthesis.

Principle

In order to be able to carry out photosynthesis, plants need, among other nutrients, above all carbon dioxide.

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Other teacher information (2/3)

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Learning objective

The students should realise that plants consume carbon dioxide when illuminated.

Tasks

The students determine the carbon dioxide consumption in photosynthesis during illumination.

Other information (3/3)

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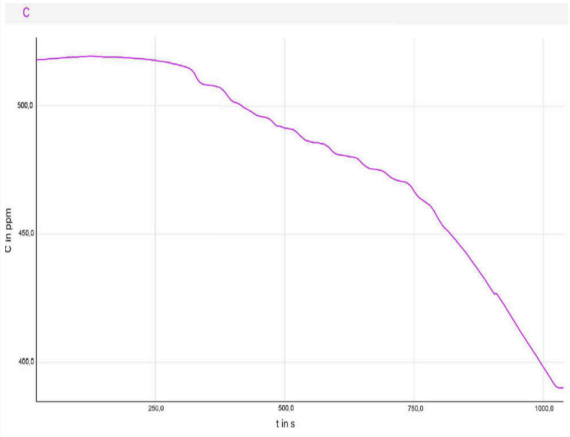
Further information on the results

- The carbon dioxide concentration decreases from 570 ppm to 450 ppm in this measurement example.
- Photosynthesis is started by the light: The water plant consumes carbon dioxide and water to produce glucose and oxygen. The carbon dioxide concentration therefore decreases.
- This experiment also allows quantitative results.
- The photosynthesis rate depends not only on external factors such as light intensity, carbon dioxide concentration and temperature, but also on the leaf area and the plant species.



Carbon dioxide content drops from 570 ppm to 450 ppm

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Safety instructions

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- The general instructions for safe experimentation in science lessons apply to this experiment.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense CO2 - Sensor for measuring the carbon dioxide content 0 ... 100000 ppm (Bluetooth + USB)	12932-01	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with screw threads	02035-00	1
3	Support base, variable	02001-00	1
4	Lab jack, 150 x 150 mm	02074-02	1
5	Ceramic lamp socket E27, with reflector, switch and security plug	06751-01	1
6	Filament lamp, 220V/120W, with reflector	06759-93	1
7	Volumetric flask 1000ml, IGJ24/29	36552-00	1
8	Rubber stopper 26/32, 1 hole 7 mm	39258-01	1
9	PVC tubing, inner dia. = 7 mm, l = 1 m	03985-00	1
10	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Additional material

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Position	Art. No.	Designation
1		Mobile device (smartphone / tablet)
2	14581-61	measureAPP
3		Water plant (Elodea canadensis)
4		Tap water

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Setup & Procedure

Set-up (1/3)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

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Set-up (2/3)

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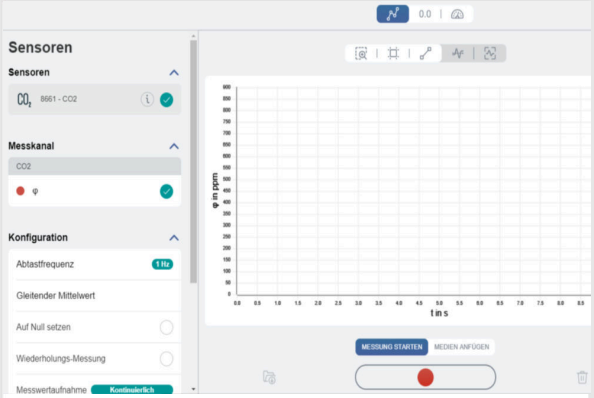

User interface measureApp

in the Windows 10 version

- Switch on the SMARTsense CO_2. Press and hold the power button to switch on the sensor.
- Connect the sensor in the measureAPP under the item "Measure" to the device as shown in the figure on the left.
- The SMARTSense CO_2 sensor is now displayed in the app.
- Calibrating the sensor: Press the power button for 7 seconds. This automatically calibrates the sensor to 400 ppm (corresponds to the CO_2-concentration of fresh air).

Set-up (3/3)

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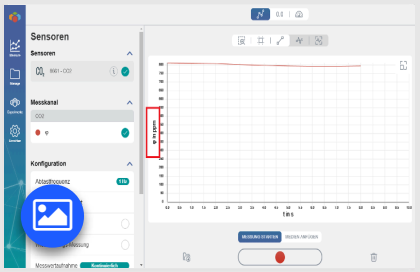
- Set up the experiment as shown in the picture on the top right.
- Place the water plant in the Erlenmeyer flask and fill up to the 250 ml mark with water.
- Connect the Erlenmeyer flask to the Cobra SMARTsense sensor CO_2 including the rubber stopper.
- Attach the lamp to the other rod with the double socket.
- Place a beaker filled with water as a heat filter between the lamp and the Erlenmeyer flask.
- The concentration is measured in ppm.



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Procedure

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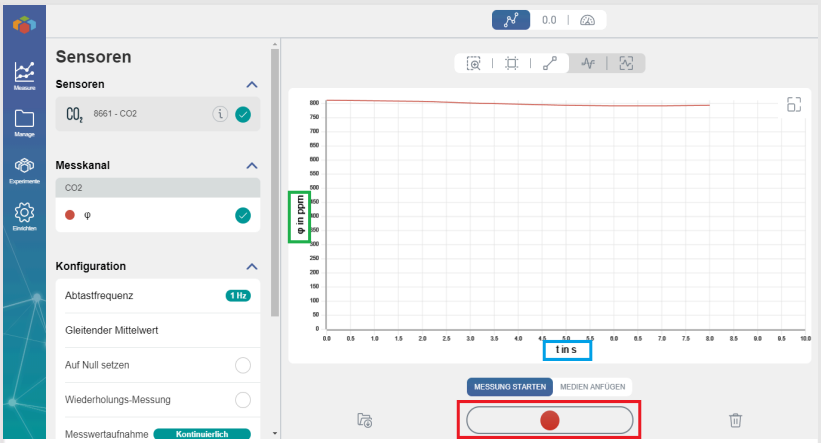
- Start recording of measured values.
- After 2 minutes, switch on the lamp and point it at the Erlenmeyer flask.
- Stop the measurement after 15 minutes.
- Save measurement.



Red border: Measurement start/stop; Blue border: Time in seconds; Green border: CO_2 in ppm

Report

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Task 1

Drag the words into the correct places.

Photosynthesis causes a decrease in _____, as this is needed by the plant for _____. In addition to this, the plant needs _____ in the form of light and _____. During photosynthesis, the plant produces _____ as well as oxygen.

- water
- energy
- carbon dioxide
- glucose
- creating plant mass

Check

Task 2

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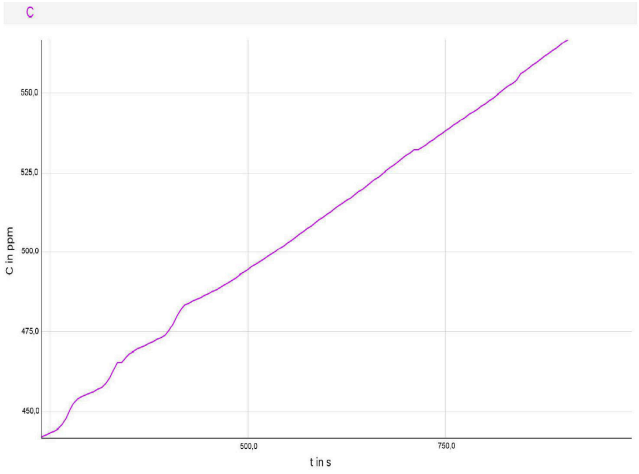
On the right you see an experimental curve that runs exactly opposite to the results you made. Why is that?

- The curve shows cellular respiration. In the dark, the plant consumes oxygen and glucose and releases carbon dioxide and water.
- That is not correct. The curve shows the curve I measured in this experiment and represents the change in carbon dioxide concentration during photosynthesis.



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Task 3

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Choose the correct statements.

- [ ] In addition to carbon dioxide and water, the plant needs energy in the form of light to carry out photosynthesis.
- [ ] In photosynthesis, plants consume glucose and oxygen to produce carbon dioxide and water.
- [ ] In photosynthesis, plants consume carbon dioxide and water to produce glucose and oxygen.

Check

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