Photosynthesis of aquatic plants with Cobra SMARTsense

Chemistry > Organic chemistry > Biochemistry

Biology > Biochemistry

Applied Science > Medicine > Biochemistry

Difficulty level	Group size	Preparation time	Execution time
medium	2	20 minutes	30 minutes

This content can also be found online at:

http://localhost:1337/c/5f6811dae5cabf0003972820

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General Information

Application

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Experiment set-up

Photosynthesis is performed by all green plants. On land this seems plausible, after all, organisms absorb gas and release gas. In water this only makes sense if you remember that water is a good solvent. Not only salts dissolve well in water, but also other liquids such as ethanol. However, many gases are also substances that can dissolve in water. Carbon dioxide (CO_2) dissolves in water in the form of carbon dioxide and also oxygen (O_2) dissolves.

For this experiment it is important to know that gases are contained in water and that aquatic plants absorb carbon dioxide and release oxygen. In this experiment, the photosynthesis of aquatic plants will be examined.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

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Prior knowledge

Plants absorb the carbon dioxide dissolved in water and release oxygen, they carry out photosynthesis.

Scientific principle

This experiment is based on photosynthesis of algae and the relationship between photosynthesis and the gas pressures of CO_2 and O_2.

Other teacher information (2/2)

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Learning objective

This experiment is suitable as a demonstration experiment for the teacher or as a practical experiment for biology studies. The CO_2-sensor also allows quantitative measurements, whereby the photosynthetic activity of aquatic plants is investigated. In this test description, the qualitative change in CO_2-concentration in parts per million (ppm) depending on the light intensity (light irradiation - normal conditions - darkness).

Tasks

Measurement of the increase and decrease of CO_2-content in the air in a reaction vessel containing an aquatic plant.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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Safety instructions

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Note that the CO_2-sensor does not come into contact with the water. Measured is the CO_2-concentration in the air.

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

Theory

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As mentioned at the beginning, gases also dissolve in water. The CO_2which is present as carbonic acid, is absorbed by plants and converted into oxygen with the help of sunlight. In this context it is also interesting to know that most of the CO_2 in the atmosphere is not converted into oxygen by the rainforest or the boreal coniferous forests, but cyanobacteria, microscopic algae, are responsible for it.

For this experiment, it is also important to know that everything is in a chemical equilibrium and that this equilibrium is not rigid but dynamic. This means that the reaction does not come to a standstill; rather, the chemical equilibrium is reached when the back reaction is as fast as the forward reaction. This also applies to solutions. In the air are O_2 and CO_2 are present as gases and are dissolved in water. If the CO_2-content in the air, it always dissolves in water. This can easily be determined by the pH value of the water. If the O_2-content in the water, this in turn goes into the air, because the gas pressure of oxygen in the air is in line with the O_2-content of the water in balance. This makes it possible to measure the photosynthesis of water plants.

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Robert-Bosch-Breite 10
37079 Göttingen

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info@phywe.de
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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - CO2, 0 ... 100000 ppm (Bluetooth + USB)	12932-01	1
2	Photosynthesis Experiment Chamber, 29 cm (11.4"), fits the Cobra SMARTsense sensors	64837-00	1
3	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Robert-Bosch-Breite 10
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info@phywe.de
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Structure and implementation

Set-up (1/2)

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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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Robert-Bosch-Breite 10
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Set-up (2/2)

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Water plague - Elodea

First the reaction chamber is built up by closing the three holes on top of the lid with the enclosed rubber plugs. Then place the water pest in the reaction vessel and add water until the reaction chamber is filled. Next, the sensor should be coupled to the smartphone by selecting the "SMARTsense sensor CO2" in measureAPP under "Sensors". The recommended measurement is "continuous". In addition, the sensor "can be set to zero", which ensures comparability.

Please note: Under no circumstances bring the CO2 sensor probe into contact with water!

Procedure (1/3)

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Experiment set-up

The first part of the experiment is performed under normal lighting.

The measurement can start when the sensor has been inserted into the vessel through a rubber plug with a hole. After ensuring that the chamber is sealed, the measurement can start.

The experiment should take a few minutes until the CO_2-concentration no longer changes.

The second part of the experiment is carried out under lighter conditions. A desk lamp or direct sunlight can be used for this. Before the measurement, the lid should be removed so that the CO_2-concentration of the air.

For measurement, proceed as above.

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Procedure (2/3)

dark structure

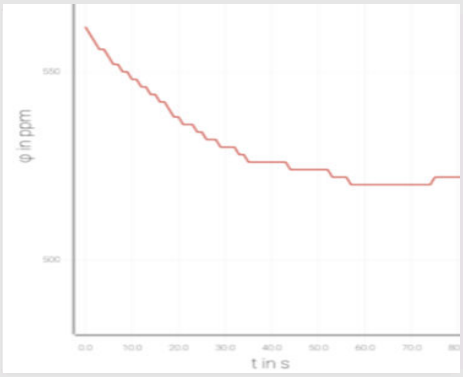
The third and last part of the experiment is carried out in the dark. The reaction chamber can be covered with a blanket or a cardboard.

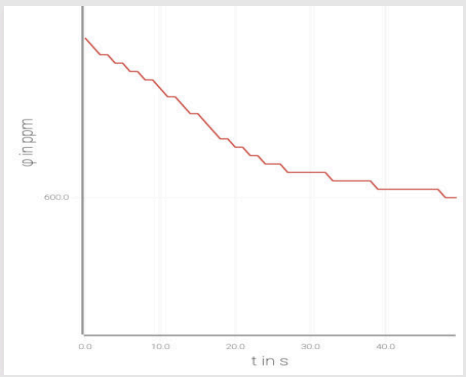
The measurement is analogous to the first two parts.

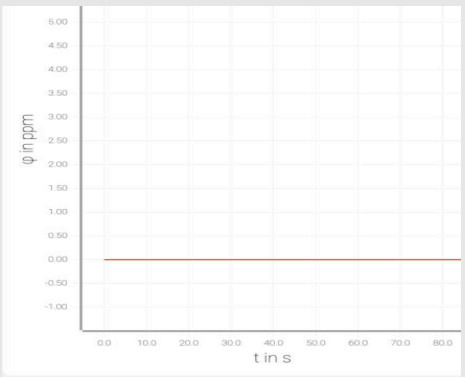
Note: For better results, carbonate can be added to the water in the form of baking powder.

Procedure (3/3)

The results should look similar to those shown below. Under direct lighting, the CO_2-concentration slower. In the dark, it stays at the same level. The left picture shows the results under normal light; the middle one under illumination; the right one in the dark. (The scales for the time axis are not the same).







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Evaluation

Report (1/3)

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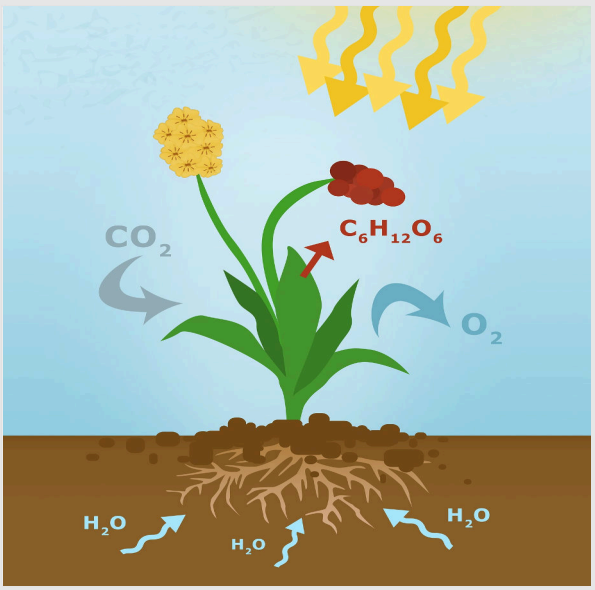

What is responsible for most of the carbon dioxide converted into oxygen?

- Soya plantations
- The tropical rainforests
- The boreal coniferous forests
- Cyanobacteria

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Report (2/3)

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What is needed for photosynthesis?

- [ ] Water (H2O)
- [ ] Oxygen (O2)
- [ ] Carbon dioxide (CO2)
- [ ] Glucose (C6H12O6)

Check

Report (3/3)

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Why is it possible to determine the O2 content in the water in the air above the water?

- It's not possible. Water and air are as different as fire and water.
- Because oxygen does not dissolve in water and immediately rises to the air as bubbles and is not present in the water at all.
- Because the O2 content of the water is in equilibrium with the air. If there is more in one, the balance is reset and there is more in the other.

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Slide	Score / Total
Slide 15: CO2 content of the atmosphere	0/1
Slide 16: Photosynthesis	0/2
Slide 17: Equilibrium: gas and liquid phase	0/1

Total points 0 / 4

Show solutions Repeat

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