Determination of soil quality with Cobra SMARTsense

Biology | Ecology & environment | Soil examination

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/5f67c84fe5cabf00039727de

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Teacher information

Application

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Soils are huge carbon sinks, i.e. they absorb more carbon (through photosynthesis) than is released by microorganisms during respiration. This function as a carbon sink is enormously important for the global climate, because the total area of soil is enormous. About 29% of the total area of the earth is covered with soil.

However, climate change is influencing this function as a carbon sink: due to the increase in temperature, the respiration of microorganisms increases to a greater extent than the photosynthesis of plants. So it can happen that soils become a source of carbon in the long term.

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Other teacher information (1/5)

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Prior knowledge

To understand this experiment, students should be familiar with photosynthesis and the basic principle of climate change. It is also important to know that there are both aerobic and anaerobic metabolic processes. The presence of different soil types should also be known.

Scientific principle

Various metabolic processes take place in a soil. These depend on the composition of the soil and can be reflected in the carbon dioxide content of the soil in a nutritional way.

Other teacher information (2/5)

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Learning objective

Students should recognize that different soil types contain different amounts of carbon dioxide.

Tasks

The students are to be familiarised with the Cobra SMARTsense CO_2-sensor to determine the carbon dioxide content of various soil types and draw conclusions about the activity of the soil and its function as a carbon sink. The beakers used must be tightly sealed with cling film. Even better is to use an Erlenmeyer flask with a stopper into which the sensors fit exactly to avoid air exchange.

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Other teacher information (3/5)

Ground respiration

- Soil respiration is composed of approx. 70% microbial respiration and approx. 30% root respiration.
- During microbial respiration, dead plant parts are decomposed by the microorganisms present in the soil. The carbon stored during photosynthesis is released and released into the air through the respiration of the microorganisms.
- The soil respiration is closely linked to the seasons. In winter it is lower than in spring due to the lower temperatures.
- Soil respiration is also bound to oxygen. If little oxygen is available, less soil respiration takes place.

Other teacher information (4/5)

Influence on the plants present

- Depending on how the soil is structured, different plants occur.
- In the moor, for example, which has very oxygen-poor soils that accordingly release little carbon dioxide, plants such as sedges and sundew are found.
- Other plants, for example many Ficus species, require rather well aerated soil with a high oxygen content.

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Other teacher information (5/5)

Floor types

- Which soil type occurs at which location depends on various factors:
  - Vegetation
  - Climate
  - Source rock
  - Use

- Frequently occurring soil types according to the Federal Environment Agency are:
  - Brown earths
  - Parabraunerden
  - Pseudogleye
  - Pod console

Safety instructions

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

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Student Information

Motivation

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A floor is composed of different materials. It contains both "dead", i.e. inorganic, and living, i.e. organic material.

Organic material needs oxygen to survive. This so-called microbial respiration is very similar to our respiration in its basic principle: oxygen is consumed and carbon dioxide is released.

The following experiments should help you to better understand these processes.

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Tasks

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Measure the carbon dioxide content of various potting soils from the DIY store (e.g. growing soil, orchid soil, topsoil), soil from a bed in the vicinity of your school, soil from a compost heap and soil from a river bed using the Cobra SMARTsense sensor CO_2.

Afterwards, select a sample for which you have already measured the carbon dioxide content. Place this sample in a microwave oven at the highest setting for 3 minutes and then measure the carbon dioxide content again.

Additional test Also measure the oxygen present above a floor with the Cobra SMARTsense Sensor Oxygen.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - CO2, 0 ... 100000 ppm (Bluetooth + USB)	12932-01	1
2	Cobra SMARTsense - Oxygen, 0 ... 20 mg/l (Bluetooth + USB)	12933-01	1
3	Plug with hole for use with Cobra SMARTsense CO2	12932-10	1
4	Erlenmeyer flask, stopper bed, 250 mlSB 29	MAU-EK17082306	2
5	Rubber stopper 26/32, 1 hole 7 mm	39258-01	1
6	Rubber stopper,d=32/26mm, 1 hole	39258-18	1
7	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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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

Set-up (2/2)

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Structure of the experiment

- Pour 50 grams of the respective soil sample into a beaker and label it.
- Create two beakers from one soil sample.
- Make sure that Bluetooth is enabled on the mobile device.
- Switch the respective "Cobra SMARTsense" sensor (CO2 (Fig. 1)/**Additional test**Oxygen (Fig. 2)) by pressing the power button.
- Open the PHYWE measureAPP and select the suitable sensor (CO2/**Additional test**: Oxygen (Oxygen)) off.

1

2

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Procedure

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Performing the measurement

- Insert the Cobra SMARTsense CO2 sensor into the beaker from above and seal it as tightly as possible with a piece of cling film. Even better is to use an Erlenmeyer flask with a stopper into which the sensors fit exactly to avoid air exchange.
- Read the value in the PHYWE measureAPP and note it down.
- Leave the sensor overnight in one of the selected soil samples and read the value again the next day.
- **Additional test**Also select a soil sample. Insert the Cobra SMARTsense Oxygen sensor into the beaker from above and seal it as tightly as possible. Read the value in the PHYWE measureAPP and write it down. Leave this sensor in the beaker overnight and read the value again the next day.

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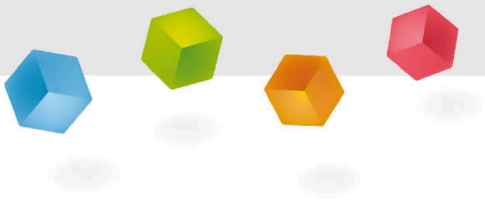

Report

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Task 1

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Why does the content of carbon dioxide increase overnight in the beaker?

- Because carbon dioxide collects on the Cobra SMARTsense sensor.
- Because the microorganisms in the soil breathe. Oxygen is absorbed and carbon dioxide is released.
- He does not. Carbon dioxide levels remain constant throughout the night.
- Because the microorganisms in the soil breathe. In the process, nitrogen is absorbed and carbon dioxide is released.

Task 2

PHYWE

The microorganisms need oxygen to breathe. So if the soil is not well aerated, i.e. not supplied with oxygen, the microorganisms die and the decomposition of dead material takes much more time or in drastic cases cannot take place (e.g. bog corpses).

○ True ○ False

Check

If the content of carbon dioxide in the beaker increases overnight, the content of oxygen also increases.

○ True ○ False

Check

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Task 3

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Why must the beaker be sealed as tightly as possible?

To prevent the measurement results from being falsified. If the beaker is not sealed tightly enough, air from outside will enter the beaker and the value will no longer be accurate.

Because otherwise the glass develops a very strong smell.

To prevent the sensor from falling out of the glass.

Don't be. Closing the glass is unnecessary and should not be done to save plastic film and protect the environment.

Task 4

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What exactly does the microwave oven do?

- ○ Nothing. Microwave radiation has no effect on the creatures in the ground.
- ○ All living things in the soil become more active. A strong change in carbon dioxide content (decreases) and oxygen content (increases) can be measured.
- ○ All living things in the ground are killed. Neither a change in the carbon dioxide content nor in the oxygen content can be measured.

Check

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Task 5

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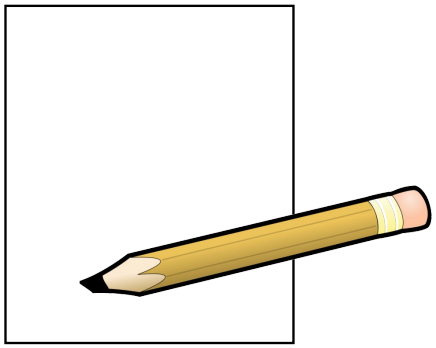
Compare the different values you have measured, which you have entered in a table and discuss their meaning in class.



Slide	Score / Total
Slide 17: Carbon dioxide content	0/1
Slide 18: Multiple tasks	0/2
Slide 19: Closed beaker	0/1
Slide 20: Microwave oven	0/1

Total amount 0 / 5

Solutions Repeat

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