Learning stations with Cobra SMARTsense (outdoor)

Biology | Ecology & environment | Water analysis

Biology | Ecology & environment | Soil examination

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

This content can also be found online at:

http://localhost:1337/c/5f458f539a658b00033e02af

PHYWE

Teacher information

Application

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This experiment is an excellent preparation for many other experiments: At four different stations, the students explore the content of the **Experiment kit** and learn how to use the Cobra SMARTsense sensors. This gives them the opportunity to take valuable first steps in scientific work and sensitises them to the subject of ecology and the environment.

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Other teacher information (1/2)

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Prior knowledge

For this experiment you will need some additional, readily available materials:

Several paper cups or glasses, large cup, spoon, pipette, kettle, distilled water, tap water, still mineral water, carbonated mineral water, water from a stream or lake, rain water, vinegar, diluted sodium hydroxide solution, 3M potassium chloride solution, salt, sugar or sugar cubes.

Scientific principle

The handling of the PHYWE experiment case is very intuitive. Since exact results and measured values are important in science, the students should be familiarized with the individual sensors of the Cobra SMARTsense system in group work to prepare them for the applications of contemporary measurement techniques in higher grades.

Other teacher information (2/2)

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Learning objective

The students should learn the correct handling of scientific experiments and the Cobra SMARTsense sensors.

Tasks

Students use the Cobra SMARTsense system to measure conductivity, pH, weather parameters such as air pressure, air temperature and humidity, brightness and temperature in soil and water.

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Additional equipment

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Position	Equipment	Quantity
1	Several paper cups or glasses	1
2	Beaker	1
3	Spoons	1
4	Kettle	1
5	Distilled water	1
6	Tap water	1
7	Non-carbonated mineral water	1
8	Sparkling mineral water	1

Position	Equipment	Quantity
1	Water from a stream or lake	1
2	Rainwater	1
3	Vinegar	1
4	Diluted sodium hydroxide solution	1
5	3M potassium chloride solution	1
6	Salt	1
7	sugar or sugar cubes	1

Safety instructions

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- Even highly diluted caustic soda lye should not come into contact with skin and eyes. Wear gloves and protective goggles.
- Long-term storage of the pH electrodes is best carried out in 3 M KCL solution, briefly in the protective sleeves supplied in tap water.
- Never store the pH electrodes in distilled water and never allow them to dry out.
- If absolute pH values are to be measured, the pH electrode should first be calibrated, e.g. with buffer tablets pH 4 and buffer tablets pH 10.
- If necessary, the conductivity sensor can be calibrated by a 1-point calibration.
- For this experiment the general instructions for safe experimentation in science lessons apply.

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Tasks (1/4)

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Station 1: Conductivity

Subtask A Measure the conductivity of distilled water.

Subtask B/C Compare the conductivity value of distilled water with that of salt water (B) and sugar water (C).

Subtask D Measure and compare the conductivity of tap water, non-carbonated mineral water, water from a stream or lake and rainwater.

Subtask E In what concentration can you still taste salt?

Tasks (2/4)

PHYWE

Station 2: pH value

Subtask A Measure the pH value of distilled water.

Subtask B: Measure the pH of vinegar.

Sub-Task C Put a drop of vinegar in a glass filled with distilled water.

Subtask D Measure the pH of the diluted sodium hydroxide solution.

Subtask E Mix vinegar and the diluted caustic soda lye and measure the pH-value.

Subtask F Measure the pH value of carbonated mineral water: once for fresh water and once for stirred water.

Cobra SMARTsense pH

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Tasks (3/4)

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Station 3: Weather

Subtask A Measure the current air pressure with the Cobra SMARTsense Absolute Pressure (Fig. 1)

Subtask B Measure with the Cobra SMARTsense Absolute Pressure Air pressure difference between the lowest and the highest floor (1 mbar difference corresponds to a height difference of approx. 8 m).

Sub-Task C Measure the air temperature and humidity in a cold and a warm room with the Cobra SMARTsense Temperature and Humidity Sensors.

Subtask D Measure the brightness with the Cobra SMARTsense Light sensor (Fig. 2) in different areas of the classroom.

1

2

Tasks (4/4)

PHYWE

Station 4: Temperature

Subtask A Measure the temperature of the ground at different depths (see picture on the right) with the temperature sensor. Dig a hole in the ground, then insert the sensor as deep as possible into the side.

Subtask B Measure the temperature of hot water and observe how the temperature changes if you leave the sensor in the water while the water cools down.

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Student information

Motivation

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Experiments in scientific fields make it possible to understand many principles of nature and technology better and more easily. In the following experiments you will learn how to determine various important parameters of soil, water and air. In this way, you can explain some things that you may not have known before.

You will be equipped with the latest technology and can make your first attempts in the safe handling of the Cobra SMARTsense system, so that you can gradually master more profound tasks.

Create a measuring protocol with tables in which you enter the measured values, then your protocol is easier to read.

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Equipment

Position	Material	Item No.	Quantity
1	Student set Environment and outdoors digital, TESS advanced Biology	12626-88D	1
2	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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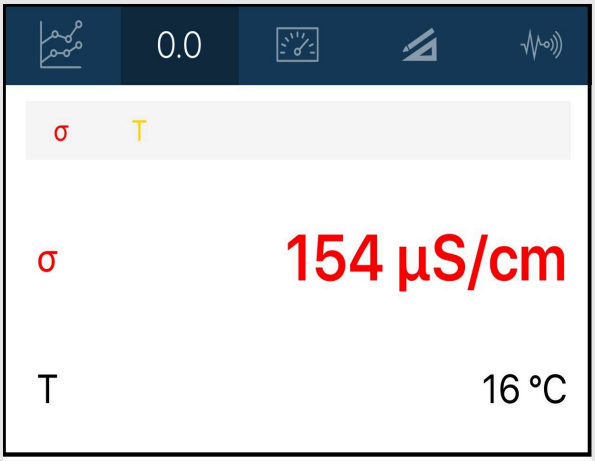
How you measure with the sensors

- Make sure that Bluetooth is enabled on the mobile device.
- Turn on the "Cobra SMARTsense" sensors by pressing the on switch.
- Open the PHYWE measureAPP and select the desired sensor.
- You must repeat this setting at each station for each new sensor. Disable unneeded sensors in the app so your classmates can measure with them. Only one person at a time can take measurements with them.



Select the suitable measuring setting in the PHYWE measureAPP (here: digital display)

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Procedure (1/4)

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Station 1: Conductivity

Subtask A Insert the "Cobra SMARTsense Conductivity" sensor into a glass of distilled water and wait until the value stops fluctuating.

Subtask B Insert the "Cobra SMARTsense Conductivity" sensor into a glass of salt water and wait until the value stops fluctuating.

Sub-Task C Place a sugar cube in a glass of distilled water, insert the "Cobra SMARTsense Conductivity" sensor into the glass and wait until the value stops fluctuating.

Subtask D Insert the "Cobra SMARTsense Conductivity" sensor into the various water samples and wait until the value stops fluctuating.

Subtask E Mix a weighed quantity of salt with 100 ml of water. Taste it. If you can still taste the salt, reduce the amount of salt a bit next time.

Procedure (2/4)

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Station 2: pH value

Subtask A Insert the "Cobra SMARTsense pH" sensor into a glass of distilled water and wait until the value stops fluctuating.

Subtask B Insert the "Cobra SMARTsense pH" sensor into a glass of vinegar and wait until the value stops fluctuating.

Subtask C Insert the "Cobra SMARTsense pH" sensor into a glass with diluted caustic soda lye and wait until the value no longer fluctuates.

Subtask D Insert the "Cobra SMARTsense pH" sensor into a glass containing a mixture of vinegar and diluted sodium hydroxide solution and wait until the value stops fluctuating.

Subtask E Insert the "Cobra SMARTsense pH" sensor into the two glasses of water and wait until the value stops fluctuating.

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Procedure (3/4)

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Station 3: Weather

Subtask A/B: Measure the current air pressure with the "Cobra SMARTsense Absolute Pressure". With this sensor you can also measure the altitude based on the air pressure. Try this on the highest and lowest floors of your school. Ask your teacher to explain to you how the difference in altitude can be determined using the pressure difference.

Sub-Task C: Measure the temperature and humidity in a cold and a warm room in your school with the "Cobra SMARTsense" sensors Temperature and Humidity. The sensors should briefly adapt to the environment.

Subtask D Take the measurement in an area of the school where it is ensured that only light from one light source (e.g. window) can fall on the opening of the light sensor. Measure the distance from the window by taking large steps and enter the values for 1 m, 5 m and 10 m in the table. Place the measuring device on the floor. The opening of the light sensor is directed towards the window. If you think that your measurement results are not accurate, repeat the measurement.

Procedure (4/4)

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Station 4: Temperature

Subtask A: Your teacher dug a hole in the school grounds. At the end of the hole there are holes at different depths where you can put the probe. First measure the temperature with the probe by moving the probe quickly back and forth several times until the temperature does not change anymore. The adjustment of the temperature in the ground is faster.

Subtask B You should measure how the temperature curve of cooling water is. Before you carry out the experiment, describe what cooling behaviour you expect. Your teacher will provide you with hot water in a large beaker. Insert the sensor into the hot water, wait until the temperature reading on the display stops rising and log the current temperature once per minute.

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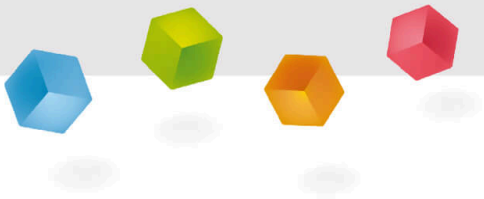

Report

Task 1

PHYWE

Which statements are correct?

- [ ] The conductivity value of distilled water is lower than that of salt water.
- [ ] The conductivity value of carbonated water is higher than that of distilled water.
- [ ] The conductivity value of sugar water is lower than that of salt water.
- [ ] If the carbon dioxide content decreases, the conductivity value also decreases.
- [ ] The conductivity value of sugar water is higher than that of salt water.

Check

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Task 2

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If you add a drop of vinegar to distilled water, the pH will drop.

○ True ○ False

Check

A lye has a pH value that is lower than 7. An acid, on the other hand, has a pH value that is higher than 7.

○ True ○ False

Check

Task 3

PHYWE

Which statement about the weather station is correct?

The further you move away from the window, the lower the brightness.

The further you move away from the window, the higher the brightness.

In warm air the humidity is usually lower than in cold air.

With increasing altitude the air pressure increases.

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Task 4

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The temperature of the soil depends on many factors. Some of these are: planting, water content, season.

○ True ○ False

Check

In the air it takes some time until the temperature value is constant. On the ground, however, this happens more quickly. This is due to the moisture present in the ground, which transfers energy to the sensor more quickly.

○ True ○ False

Check

Task 5

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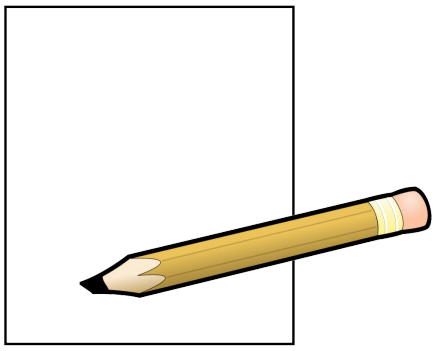
Write down the readings at each station and compare them with your classmates. Discuss in class why some values (e.g. the amount of salt you still taste) are different.



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Slide	Score / Total
Slide 21: Conductivity	0/4
Slide 22: Multiple tasks	0/2
Slide 23: Weather station	0/1
Slide 24: Multiple tasks	0/2

Total points 0 / 9

Show solutions Repeat

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