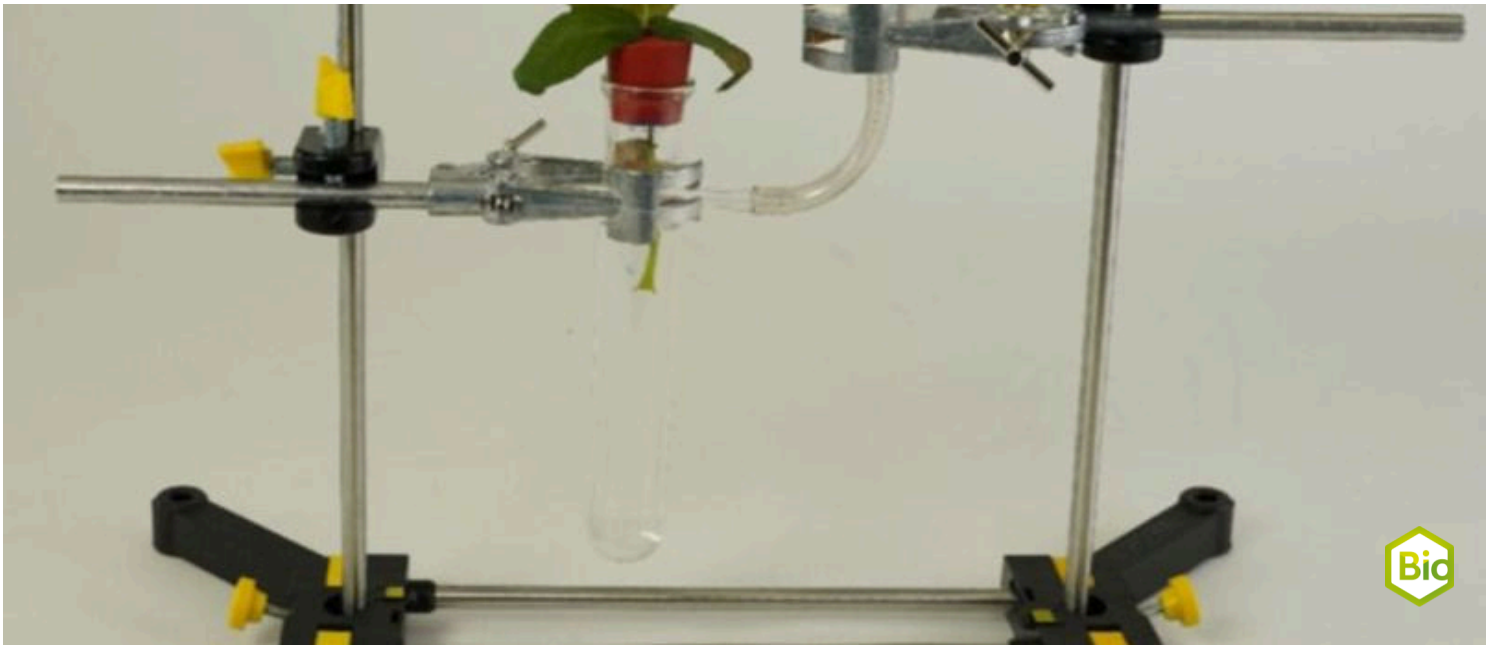
Transpiration of leaves with Cobra SMARTsense



Biology | Plant Physiology / Botany | Water & Mineral Balance

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/63485cad042185000327e705

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General information

Application

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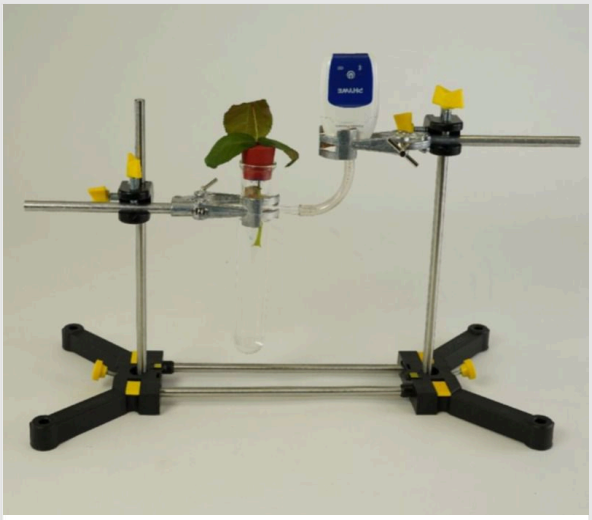

Experimental setup

The transpiration of plants serves to transport water and nutrients from the roots to the leaves. In the experiment, the pressure drop is measured, which is caused by the release of water from the leaves into the environment and which ensures the necessary flow of water from the soil.

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Other information (1/6)

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Prior knowledge

Students should be familiar with the basic principle and function of transpiration. They should also know what morphological adaptations plants have developed to their environments with regard to transpiration.

Principle

Transpiration draws water from the roots into the leaves, supplying the plant with water and nutrients.

Other information (2/6)

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Learning objective

Students should recognise that various factors influence the strength of perspiration.

Tasks

Students should measure transpiration under different environmental conditions and interpret the differences in the pressure curves.

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Other information (3/6)

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Further information on the results

Plants "sweat" like humans and are physiologically and morphologically adapted to their specific environments. When temperatures are too high, they transpire and release water into the environment. Transpiration serves to transport water and nutrients. The resulting negative pressure draws water from the roots and nutrients are transported through the trunk to the leaves. In nature, wind plays a major role in the transpiration of plants. Plants that grow on windy mountain slopes, for example, are more woody. Plants that grow in the desert, for example, sink their stomata into small leaf cavities that are additionally matted and covered with a wax layer so that transpiration by the hot desert wind is kept to a minimum. In high humidity, on the other hand, transpiration is severely restricted because the surrounding air is already heavily saturated with water. Plants living in such areas have highlighted stomata to increase their transpiration.

Other information (4/6)

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Observations and results

Experiment 1 In still air, the pressure in this test set decreased by approx. 2.8 kPa during a measuring time of 1000 s for the plant used (Fig. right).

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Other information (5/6)

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Observations and results

Experiment 2 In the cold air flow, the pressure dropped by approx. 3.8 kPa (Fig. left), in the warm air flow by approx. 6.3 kPa (Fig. right).

Other information (6/6)

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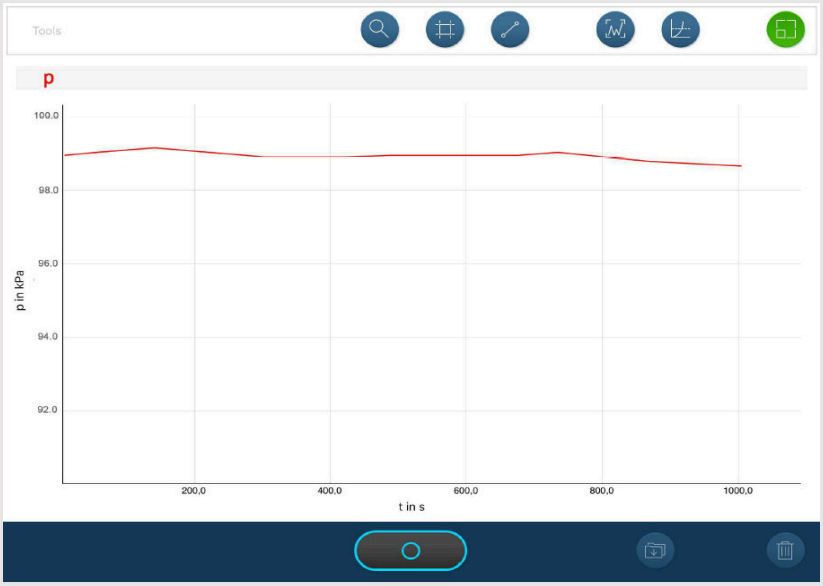
Observations and results

Experiment 3 In the water vapour there is hardly any transpiration (Fig. right).



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Safety instructions

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

Theory

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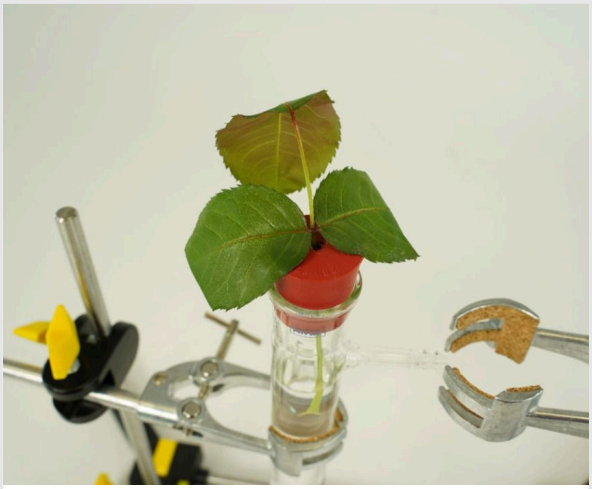

Leaves of the rose are particularly well suited for this experiment

The transpiration of plants serves to transport water and nutrients from the roots to the leaves. In the experiment, the pressure drop is measured, which is caused by the water release of the leaves into the environment and which ensures the necessary flow of water from the soil.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Absolute Pressure - Sensor for measuring the absolute pressure 20 ... 400 kPa (Bluetooth + USB)	12905-01	1
2	Support base, variable	02001-00	1
3	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with screw threads	02035-00	3
4	Boss head	02043-00	2
5	Universal clamp	37715-00	1
6	Test tube,200x30 mm,side arm,PN29	MAU-17080801	1
7	PVC tubing, inner dia. = 7 mm, l = 1 m	03985-00	1
8	Plasticine, 10 sticks	03935-03	1
9	Rubber stopper 26/32, 1 hole 1,5 mm	39258-09	1
10	Beaker, Borosilicate, low form, 1000 ml	46057-00	1
11	Rubber bands, 50 pieces	03920-00	1
12	Hot/cold air blower	04030-93	1
13	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Additional equipment

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Position	Art. No.	Designation
1		Mobile device (smartphone / tablet)
2		Plant with fleshy leaves
3		Knife
4		Plastic bag

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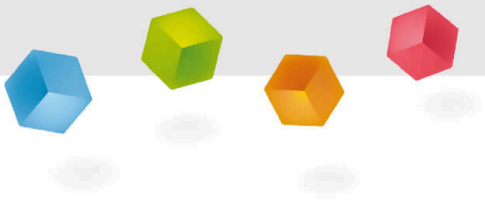

Set-up and Procedure

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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

Set-up (2/3)

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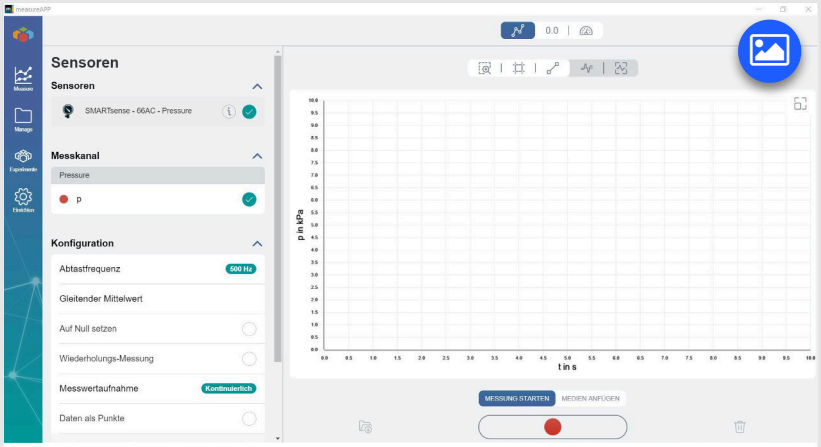

Select the Cobra SMARTsense Absolute Pressure sensor.

The Windows 10 version of measureAPP is shown here.

- Turn on the SMARTsense Absolute Pressure sensor by pressing and holding the power button.
- Connect the sensor in the measureAPP under the item "Measure" to the device as shown in the figure on the left.
- The SMARTsense Absolute Pressure sensor is now displayed in the app.

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Set-up (3/3)

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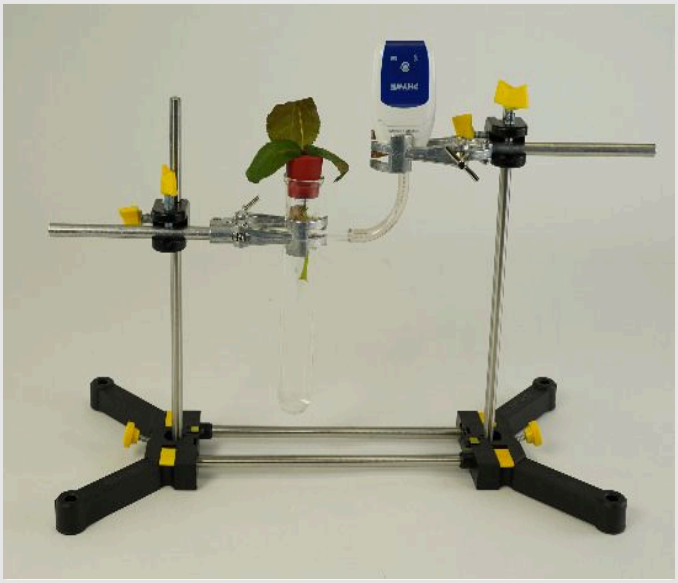
- Set up the units as shown in the illustration on the right.
- It is important that you attach the test tube to one stand rod and the SMARTsense Absolute Pressure sensor to the other. The tube intake of the pressure module should be approx. 2 cm higher than the intake of the test tube.
- Connect both intake manifolds with a piece of hose.
- Fill the test tube with water and put on the rubber stopper. Make sure that no air bubble forms in the test tube.



Procedure

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Experiment 1

- Cut off a small branch or ground plant just above the ground, peel the lower part of the branch with a knife and cut it off at an angle (45°).
- Quickly push the twig through the stopper and seal the stopper well with plasticine.
- Without delay, remove the tube from the SMARTsense Absolute Pressure sensor's suction port, put the plug with the plant on the test tube (avoid air bubbles forming in the test tube) and put the tube back on the SMARTsense Absolute Pressure sensor (this procedure is just as necessary because of the pressure compensation).
- Start measurement and calculate the difference from the start and end values.
- Write down these values as well as the values of the following experiment variants in your report. Further test variants are conceivable.

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Procedure

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Experiment 2a

- During the measurement, expose the plant to the cold air stream of the hair dryer.

Experiment 2b

- Set the hair dryer to hot air and expose the plant to the warm air stream of the hair dryer during the measurement.

Experiment 3

- Bring ½ litre of water to the boil in a beaker and collect the resulting water vapour for a few seconds with a plastic bag (Caution! Do not bring the bag into contact with the hot beaker!).
- Put the bag over the plant and close it with a rubber ring; start the measurement.

Report

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Task 1

Drag the words into the correct places.

Plants "sweat" like humans and are physiologically and morphologically adapted to their specific _____. At _____ temperatures, they transpire more and release water into the environment. The _____ serves to transport water and nutrients. The resulting negative pressure draws water from the _____ and transports nutrients through the stem to the leaves.

roots
high
transpiration
environments

Check

Task 2

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What role does wind play in the transpiration of plants?

- ○ Wind prevents transpiration completely.
- ○ Wind reduces transpiration. The plant therefore always tries to get as much wind as possible.
- ○ Wind promotes transpiration. The plants counteract this through various morphological adaptations.
- ○ Wind has no influence on transpiration.

Check

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Task 3

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Select the correct statements about plants in elevated humidity.

- [ ] At high humidity, transpiration is greatly increased because the surrounding air is already heavily saturated with water.
- [ ] At high humidity, transpiration is severely restricted, as the surrounding air is already heavily saturated with water.
- [ ] Plants living in such areas have highlighted stomata to increase their transpiration.

Check

Slide	Score / Total
Slide 20: Plants sweat	0/4
Slide 21: Wind during transpiration	0/1
Slide 22: Plants in elevated humidity	0/2

Total 0 / 7

Solutions Repeat

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