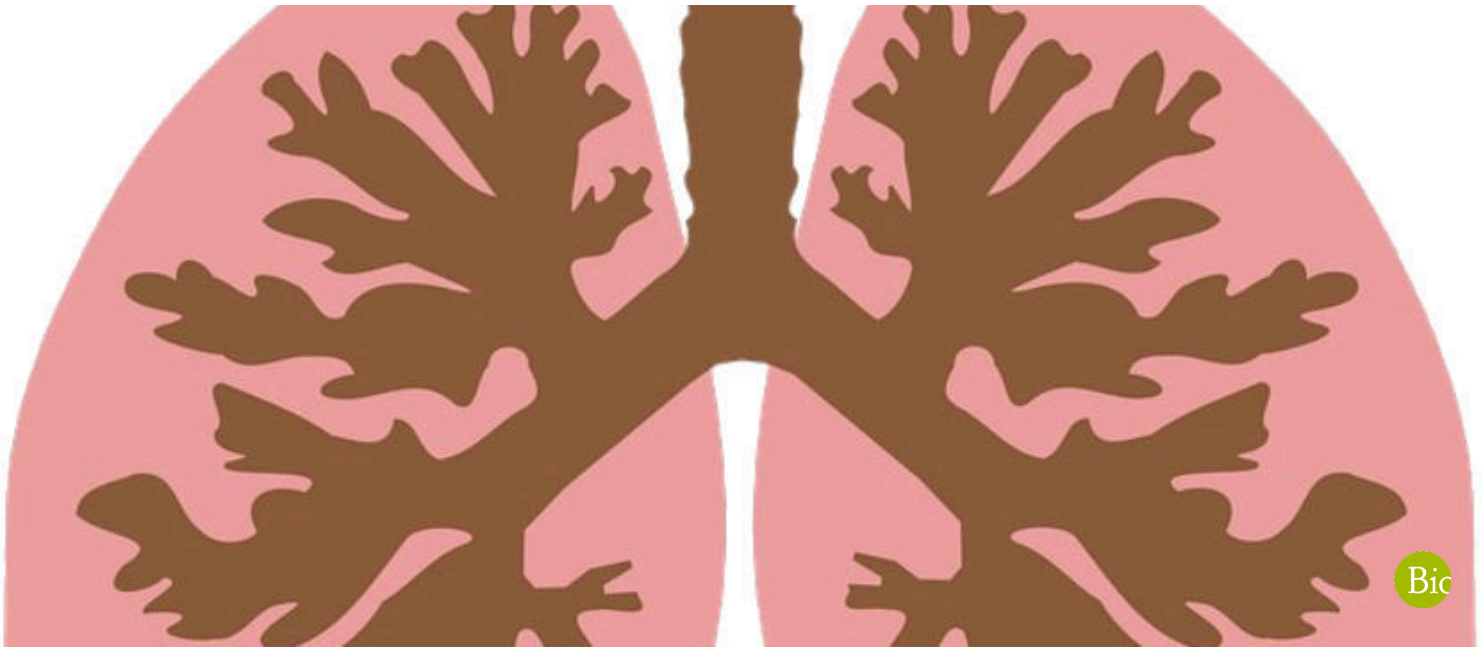
Respiration of the human being with Cobra SMARTsense



In this experiment human respiration is illustrated by measurements of the oxygen and carbon dioxide content of air. The measurements are taken before and after respiration.

Biology > Human Physiology > Respiration

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

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Teacher information

Application

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Experiment setup

In this experiment, human respiration is illustrated by measuring the oxygen and carbon dioxide content of air and breath. Without the conversion of O2 into CO2, human life and the life other beings could not exist.

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Other teacher information (1/2)

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Prior knowledge

The students should know that respiration converts oxygen into carbon dioxide, which also produces water, which is precipitated, in the experimental setup, as a humid film. Optionally, this humidity can also be measured, but is not the subject of the experiment here.

It is also helpful to know that there is about 21% oxygen and about 410 ppm carbon dioxide in air.

Principle

Oxygen is inhaled, carbon dioxide exhaled. A multiple of the normal carbon dioxide concentration is measured in the exhaled air, but the oxygen concentration does not decrease significantly.

Other teacher information (2/2)

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Learning objective

Students should recognize that breathing greatly increases the concentration of carbon dioxide, but does not greatly decrease the concentration of oxygen.

Tasks

Students measure the concentration of oxygen and carbon dioxide in the air they breathe and compare it to the normal air concentration.

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Safety instructions

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- The general instructions for safe experimentation in science lessons apply to this experiment. In particular, hygiene measures must be pointed out to the students.

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Student Information

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Motivation

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During all human activities, oxygen is inhaled and carbon dioxide is exhaled. In this process, the gas exchange through breathing can be measured with the appropriate sensors, namely how much oxygen is consumed from the ambient air and by how much the concentration of carbon dioxide increases.

Tasks

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Test setup

In this experiment students investigate how the concentration of the two gases oxygen and carbon dioxide in the air we breathe changes compared to the ambient air.

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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	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Structure and implementation (1/3)

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To measure oxygen and carbon dioxide content, the Cobra SMARTsense and measureAPP are required. The app can be downloaded free of charge from the App Store - QR codes see below. Check if Bluetooth is activated on your device (tablet, smartphone).

measureAPP für Android Betriebssysteme

measureAPP für iOS Betriebssysteme

measureAPP für Tablets / PCs mit Windows 10

Structure and implementation (2/3)

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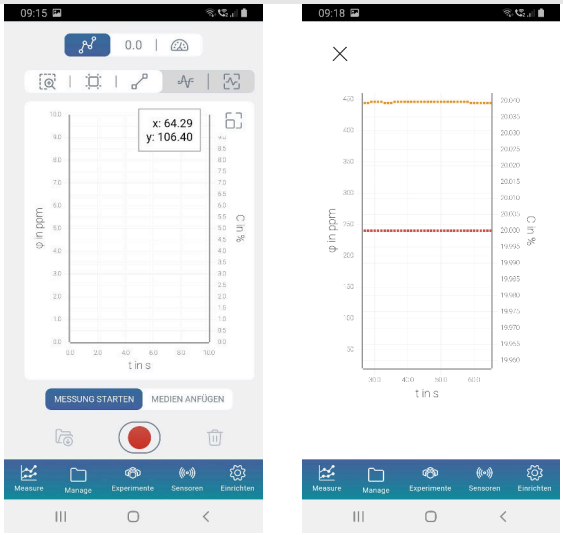

Left fig.: before measurement, right fig.: after measurement

- Activate the Cobra SMARTsense Oxygen and CO2 sensors in the measureAPP. Since the measurement scales of the two measurement channels are far apart (% and ppm respectively), make sure that the individual measurement scales are optimally set before, during and after the measurement.
- First, measure the gas concentration of ambient air with the two sensors. Make sure that both sensors are calibrated before the measurement, i.e. that they correspond to the concentrations given in the literature. Because of the low scaling of the carbon dioxide concentration (in parts per million), it depends very much on where the measurement is taken, i.e. how good the air exchange is with the air outside.

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Structure and implementation (3/3)

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Setup for collecting the breathing air

- Then, for the first measurement, put one sensor and for the second measurement the other sensor in a plastic bag in which you collect your breath.
- Start the measurement and breathe as much air as possible from your lungs into the bag. Make sure that as little air as possible escapes during the measurement. Several measurements being averaged improve the result.
- Measuring both parameters at the same time may lead to inaccurate results because the breathing air can escape more easily and thus falsifies the measurement result.
- You can do different experiments by varying the way you "collect" the air in your lungs, such as holding your breath for longer periods of time or physical exertion.

Report

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Task 1

Which of the three statements is correct?

- ○ The moisture that forms in the bag when you breathe into it is caused by the air getting warmer, which causes dew to form.
- ○ The concentration of oxygen in air depends on how warm it is.
- ○ The exchange of air between inhaled air and breathing air takes place in the lungs.

Check

Task 2

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In which blood vessels does oxygen-rich blood flow, and in which does oxygen-depleted blood flow?

- ○ Both veins and arteries transport oxygen-rich and oxygen-depleted blood in equal measure.
- ○ As a rule, the veins transport oxygen-rich blood and the arteries transport oxygen-depleted blood.
- ○ None of the other answers is correct.
- ○ As a rule, the arteries transport oxygen-rich blood and the veins transport oxygen-depleted blood.

Check

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Task 3

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Choose the correct statements.

- [ ] Respiration consumes oxygen and glucose.
- [ ] Respiration produces carbon dioxide and water.
- [ ] In the air we breathe, the concentration of carbon dioxide is as high as the concentration of oxygen.

Check

Slide	Score / Total
Slide 14: Questions about breathing	0/1
Slide 15: Blood vessels	0/1
Slide 16: Algae property	0/2
Total	**0 / 4**

Solutions Repeat

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