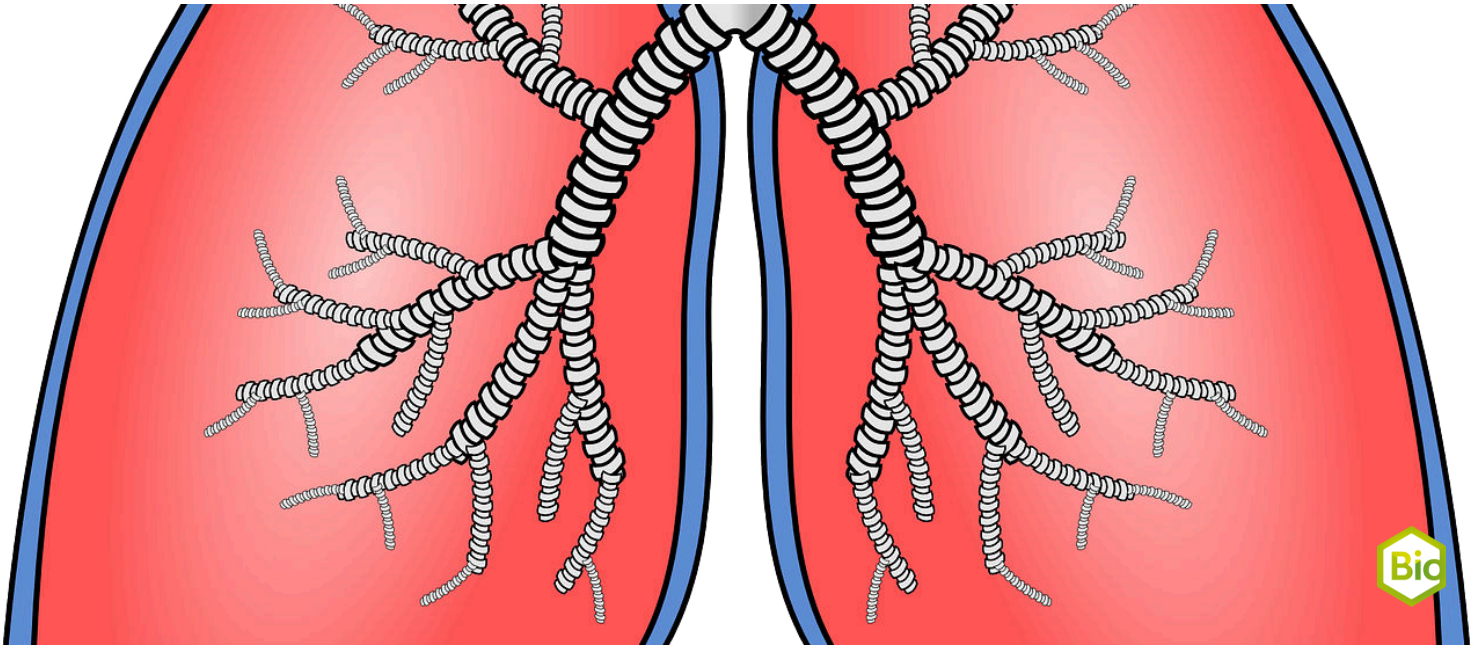
How much air can our lungs contain with Cobra SMARTsense



Biology > Human Physiology > Respiration

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/5f4c79a97b2768000356b8f5

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Teacher information

Application

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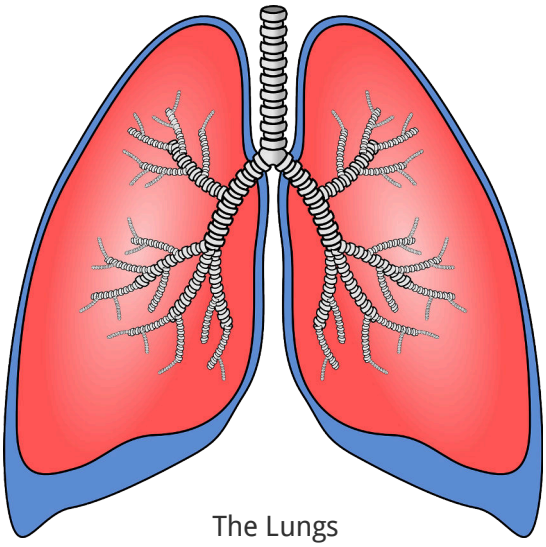

The Lungs

This experiment serves as an introduction to spirometry. Within this experiment the students should determine their vital capacity and compare and discuss it with that of others. At this point it should be mentioned that the effect that can be achieved by training to increase the vital capacity is relatively small in relation to the volumes predetermined by the body. The most important factor that determines lung volume is physique and age. For example, large people generally have a larger lung volume than smaller people (see experiment P8001269). People reach their maximum lung volume at around 20 years of age. The lung volume decreases with age.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Other teacher information (1/3)

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Prior knowledge

A general distinction is made between two different types of breathing. The "normal" respiration and the "forced" respiration. The term "normal" describes breathing as it takes place unconsciously while the body is under no strain. Forced breathing is when air is breathed in or out deliberately. Normal breathing is used to determine the respiratory volume (AZV) within this experiment, forced breathing must be used to determine the inspiratory (IRV) and expiratory reserve volume (ERV).

This experiment can be combined with the experiment P8001169, in which the vital capacity itself is measured. If it is not possible to carry out both experiments at the same time, you can have one or two test persons carry out this experiment and also experiment P8001169. It should be noticeable that the vital capacity calculated in this experiment differs from that measured directly (in experiment P8001169).

Other teacher information (2/3)

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Prior knowledge

Make sure that the test persons carry out the tests standing up. This is important to create equal test conditions for the test. The lungs behave differently in terms of volume when sitting than when standing. This ensures that the results are comparable.

Make it clear to the test persons how far they have to breathe in and out to determine the different measured variables.

Scientific principle

Information about the measuring technology: by blowing into the opening of the spirometer, a paddle wheel rotates, which is coupled with a light barrier. From the rotations of the paddle wheel, the device calculates the exhaled air volume in litres [l]. This measuring technology is also used in medical diagnostics.

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Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Other teacher information (3/3)

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Learning objective

The students should learn the principle of spirometry and determine their own vital capacity. The result is then compared with the values of others. It will be discussed what causes the different determined vital capacities of the different test persons.

Tasks

1. Determine your breathing volume (AZV).
2. Determine your expiratory reserve volume (ERV).
3. Determine your inspiratory reserve volume (IRV).

Safety instructions

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

Furthermore, for reasons of hygiene, make sure that each test person uses a new filter for the test.

The device used is not a medical measuring device. The measured values determined provide an insight into spirometry. Deviating measurement results between the test persons or the sample illustrations should not be considered pathological in the medical sense. A medically relevant evaluation can only be obtained in the context of a lung function test performed by a physician.

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Robert-Bosch-Breite 10
37079 Göttingen

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

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Student Information

Motivation (1/2)

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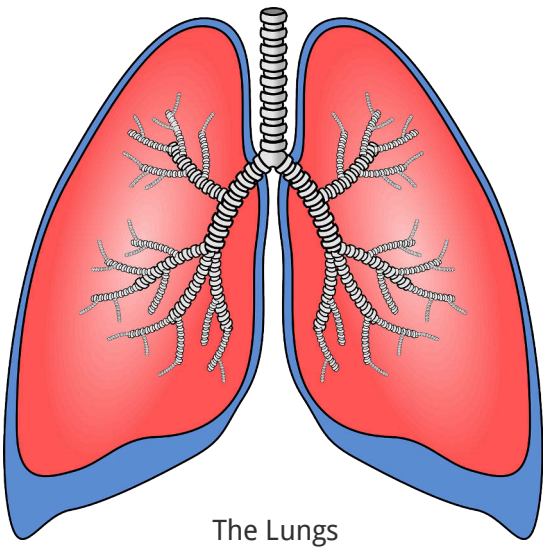

The Lungs

The lung is an organ that serves to absorb carbon dioxide (CO_2) and to breathe oxygen (O_2) to be recorded. The lungs are stretched by contractions of the diaphragm. In this way, breathing air from the environment reaches the lungs. When the diaphragm is relieved, the lung is contracted again and the air is exhaled passively.

In the following experiment, the lung volume, i.e. the amount of air that the lungs can take in, is to be determined. Spirometers are often used in medicine because they can be used to determine irregularities in lung function.

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Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
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Motivation (2/2)

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The maximum exhaled lung volume after maximum inhalation is recorded as vital capacity (**VC**). The vital capacity is composed of the respiratory volume (**AZV**) + inspiratory reserve volume (**IRV**) + expiratory reserve volume (**ERV**): **VC = AZV + IRV + ERV**

AVZ: Volume during normal inhalation.

IRV: Volume that can be inhaled additionally after normal inhalation.

ERV: Volume that can be additionally exhaled after normal expiration.

Residual volume: Amount of breathing air that always remains in the lungs when air is ventilated (approx. 1.2 L).

Using the spirometer

Tasks

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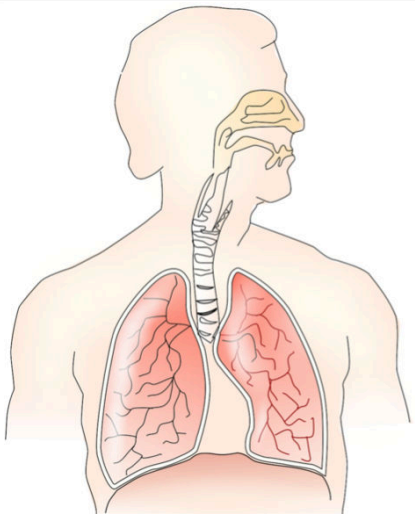

Our breathing organs

1. Determine your breathing volume (AZV).
2. Determine your expiratory reserve volume (ERV).
3. Determine your inspiratory reserve volume (IRV).

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Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Spirometer, ± 10 l/s (Bluetooth + USB)	12936-01	1
2	measureAPP - the free measurement software for all devices and operating systems	14581-61	1
3	Mouthpiece including Filter for SMARTsense Spirometer	12936-20	1

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Robert-Bosch-Breite 10
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Tel.: 0551 604 - 0
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info@phywe.de
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Set-up

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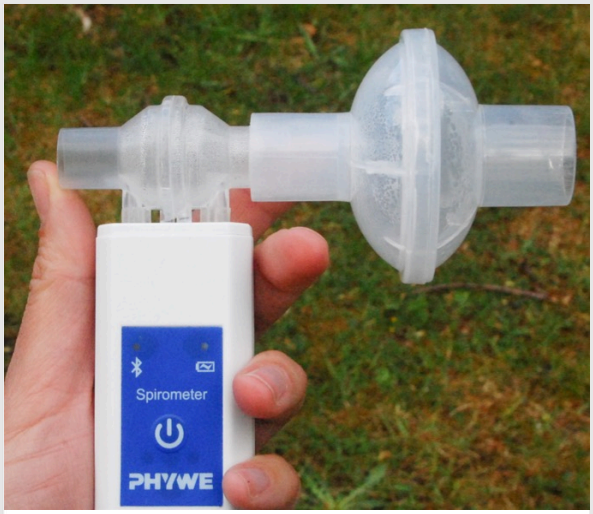

Spirometer with correctly mounted turbine

Take a filter out of its packaging and insert it into the opening provided in the spirometer unit with a short, gentle twisting motion. Make sure that each filter is only used by one person.

After that the device should look like the one shown in the picture on the left.

Procedure (1/3)

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Representation of the measurement data for the determination of the AZV

Measurement 1 (AZV): Breathe in normally while standing and hold your breath.

- Then put the mouthpiece of the spirometer in your mouth so that your lips completely enclose the mouthpiece. If necessary, hold your nose closed so that no air escapes through the nose.
- Start the measurement.
- Measure the normally exhaled volume as the breathing volume **(AZV)** in litres.
- Finish and save the measurement after you have exhaled the air.

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
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Procedure (2/3)

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Presentation of the measurement data for the determination of ERV

Measurement 2 (ERV): For this, breathe out standing up as far as you would without strain.

- Then put the mouthpiece of the spirometer into the mouth as described in measurement 1.
- Start the measurement.
- Now exhale the remaining air "pressing" as far as you can.
- Measure the volume exhaled by pressing as expiratory reserve volume (ERV) in litres.
- Finish and save the measurement after you have exhaled the air.

Procedure (3/3)

PHYWE

Representation of the measurement data to determine the IRV

Measurement 3 (IRV): To do this, breathe in standing up as far as you would do without being stressed and hold your breath.

- Then put the mouthpiece of the spirometer into the mouth as described in measurement 1.
- Start the measurement.
- Now breathe in the air "pulling" as far as you can.
- Measure the pulling inhaled volume as inspiratory reserve volume **(IRV)** in litres.
- Finish and save the measurement after you inhale the air.

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Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

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Report

Task 1

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How large is your respiratory volume (AZV) in litres?

You can use the Measure tool to examine the curves.

Measurement data for determining the AZV

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Task 2

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What is your expiratory reserve volume (ERV) in litres?

You can use the Measure tool to examine the curves.

Measurement data for determining ERV

Task 3

PHYWE

What is your inspiratory reserve volume (IRV) in litres?

You can use the Measure tool to examine the curves.

Measurement data for determining the IRV

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37079 Göttingen

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

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Task 4

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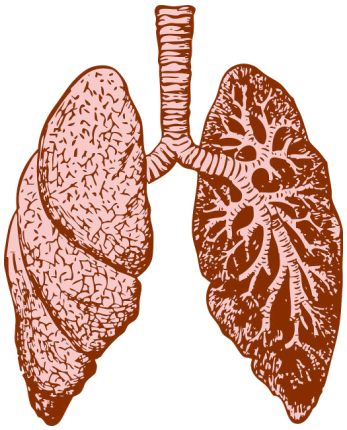

The Lungs

What is your vital capacity (VC) in litres? Calculate it with the formula from the introduction.

Example: VC = AZV + IRV + ERV = 0.5 l + 1.5 l + 1.9 l = 3.9 l

How many liters of air fit into your lungs in total? Take the residual volume into account.

Task 5

PHYWE

Drag the right terms into the gaps in the text.

During breathing, _____ is inhaled and _____ is exhaled. When the _____ contracts, the lungs are _____. When it is released, the lung is _____ again and the air is exhaled passively.

stretched
diaphragm
oxygen
carbon dioxide
contracted

Check

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Task 6

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The volume that can be additionally inhaled after normal inhalation is called the volume:

- ○ Expiratory reserve volume (ERV)
- ○ Residual volume
- ○ Inspiratory reserve volume (IRV)

Check

Polar Bear

Task 7

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The vital capacity of a person does not change in the course of his life.

○ True ○ Wrong

Check

Swimmer

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Robert-Bosch-Breite 10
37079 Göttingen

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

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Slide	Score / Total
Slide 21: Breathing	0/5
Slide 22: Volumes	0/1
Slide 23: Vital capacity	0/1

Total amount 0 / 7

Solutions | Repeat | Exporting text

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37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de