

# Direct determination of lung volume using a spirogram with Cobra SMARTsense



Biology

Human Physiology

Respiration



Difficulty level

easy



Group size

2



Preparation time

10 minutes



Execution time

20 minutes



## Teacher information

### Application



Spirometry

This experiment is suitable as a supplementary experiment to the experiment "How much air can our lungs hold?" (P8001069) to determine the respiratory volume AZV and the reserve volumes IRV and ERV, from which the vital capacity (VC) is calculated. In terms of content, if only one of the two experiments is to be performed, the introduction of the previous experiment should be discussed.

All spirometry tests can be performed with the same test components.

## Other teacher information (1/3)

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### Prior knowledge



Students should already know the cardiovascular system of the body and also the function of the lungs. They should also know what a spirogram is and what the vital capacity (VC) says.

### Scientific Principle



Within this experiment, not the individual factors of the VC are determined, but the VC itself. Furthermore, in this experiment the lung volume is shown as a function of time in the form of a so-called spirogram.

## Other teacher information (2/3)

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### Learning objective



Students will learn how to determine vital capacity (VC) in liters using the spirometer and create a spirogram.

### Tasks



Students determine their vital capacity (VC) and create a spirogram from the readings.

## Other teacher information (3/3)

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### Notes on implementation

Make sure that the subjects perform the experiments standing. If some of them are sitting and others are standing, the experimental conditions are not the same for the experiment. The lungs behave differently in terms of volume when sitting than when standing. This unnecessarily complicates the comparison between the different subjects.

Furthermore, for hygienic reasons, make sure that each subject uses his or her own mouthpiece with filter for the experiment.

Make it clear to the subjects how far they have to inhale and exhale to determine the different measures if this is not clear from the text.

## Safety instructions

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- The device used is not a medical measuring device. The measured variables provide an insight into spirometry. Deviating measurement results between the test persons or the sample illustrations must not be regarded as pathological in the medical sense. A medically relevant evaluation can only be obtained from a doctor within the framework of a lung function test.
- The general instructions for safe experimentation in science lessons apply to this experiment.
- Please make sure that each participant has his own mouthpiece with filter that he does not have to share with anyone else.

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## Student Information

### Motivation

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Measuring the lung volume with the spirometer

This test measures how large the lung volume is. The larger the lung volume, the more efficient an athlete is during continuous exercise.

For children and adolescents, the size of the lung volume is not meaningful, because it is constantly increasing during the growth phase of a person, just like other organs. Nevertheless, it is interesting to know how much air can fit in a lung.

## Tasks



1. Determine your vital capacity in liters using the spirometer.
2. Create a spirogram with the recorded readings.

## Equipment

Position	Material	Item No.	Quantity
1	<a href="#">Cobra SMARTsense - Spirometer, ± 10 l/s (Bluetooth + USB)</a>	12936-01	1
2	<a href="#">measureAPP - the free measurement software for all devices and operating systems</a>	14581-61	1

## Structure (1/2)

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To measure lung volume, you need the Cobra SMARTsense spirometer and the measureAPP. Check whether "Bluetooth" is activated on your device (tablet, smartphone) (the app can be downloaded free of charge from the App Store - QR codes below). Now open the measureAPP on your device.



measureAPP for

Android operating systems



measureAPP for

iOS operating systems



measureAPP for

Tablets and PCs with Windows 10

## Structure (2/2)

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Cobra SMARTsense Spirometer

- Turn on the Cobra SMARTsense Spirometer by pressing the power button. The sensor will be detected automatically.
- Select the Cobra SMARTsense spirometer in PHYWE measureAPP. The volume is automatically displayed as a function of time during the measurement.

The following tests are all **standing** so that the measured values can be compared with those of other persons.

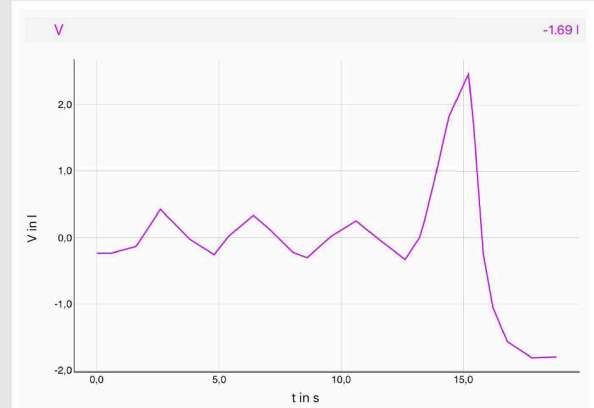


## Procedure (1/2)

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### Measurement

- Put the mouthpiece of the spirometer in your mouth so that your lips completely surround the mouthpiece.
- Hold your nose if necessary to prevent air from getting through your nose. **Launch** the measurement.
- Breathe in and out normally a few times while standing.
- Now take as many breaths as you can.
- Now exhale as much of the previously inhaled air as possible.
- Measure the exhaled volume as vital capacity (VC) in liters. **Exit** and **save** the measurement.



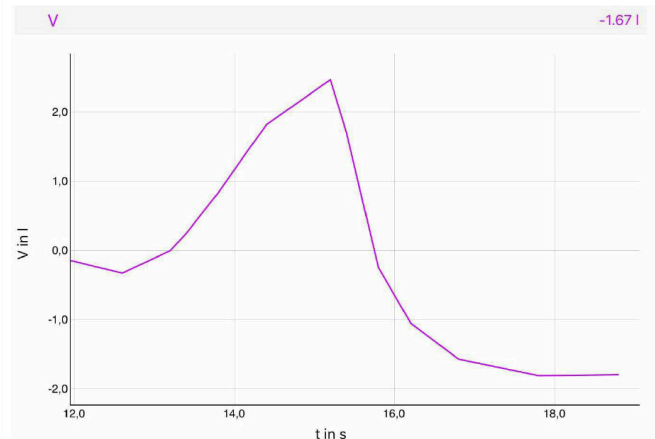
Display of the measured data for determining the VC

## Procedure (2/2)

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### Create spirogram

- Enlarge the part of your graph that represents the maximum inspiration and expiration using the Zoom tool.
- A spirogram is shown on the right. Which area of the curve shows inhalation (inspiration) and which area shows exhalation (expiration)?



Spirogram: Representation of the inspiration and expiration phase



# Report

## Task 1

Choose the correct statements.

- Lung volume is not dependent on gender, but on height, weight, age and other factors.
- It makes a difference whether the subjects perform the test sitting, standing or lying down.
- The lung volume that was determined in this test is not to be considered medically given or pathological. These statements can only be made by a doctor.

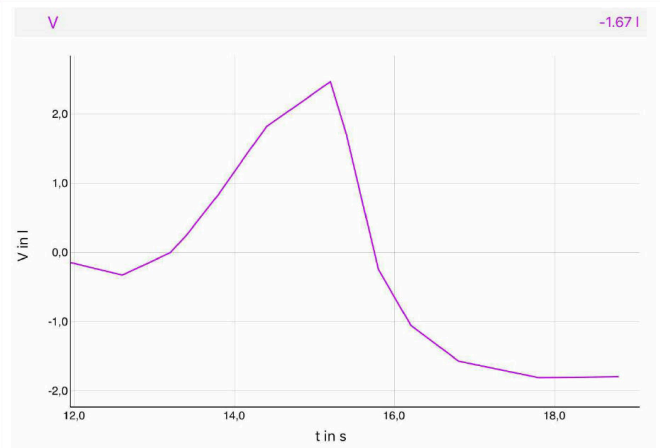
✓ Check

## Task 2

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Which area of the curve shows the inhalation (inspiration) and which the exhalation (expiration)?

- Inspiration:** the ascending range from about 13 s to 15.5 s; **Expiration:** the descending range from about 15.5 s to 17.5 s.
- Expiration:** the ascending range from about 13 s to 15.5 s; **Inspiration:** the descending range from about 15.5 s to 17.5 s.



Where do you breathe in and where do you breathe out?

## Task 3

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A spirogram represents lung volume as a function of time.

True

False

Check

The lung volume of a healthy adult human being is between 10 and 15 litres.

True

False

Check

Slide	Score/Total
Slide 16: Lung volume	0/3
Slide 17: Breathe	0/1
Slide 18: Multiple tasks	0/2

Total  0/6

 Solutions

 Repeat