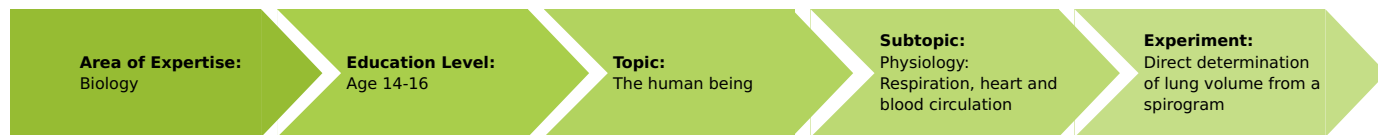


# Direct determination of lung volume from a spirogram

(Item No.: P8001160)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



30 Minutes

### Recommended Group Size



2 Students

### Additional Requirements:

- iPad or Android tablet

### Experiment Variations:

- Alternatively, use a PC with measureLAB (14580-61)
- Alternatively, use a Cobra4 Mobile-Link (12620-10)

### Keywords:

Spirogram, Vital lung capacity

## Teacher information

### Introduction

#### Principle

This experiment is suitable as a supplementary experiment to the previous IRV, ERV and AZV experiment in which the VC was determined by calculation. Because of the linked contents of these two experiments, when only one of them is to be carried out, the introduction to the other one should also be discussed.

In this experiment, both the individual factors of the VC and the VC itself are determined. Further to these, the volume of the lung is displayed against time in the form of a so-called spirogram.



Fig. 1: Using the spirometer to determine various measured values  
(left: measurement by using Cobra4 Wireless/USB-Link, on the right: Cobra4 Mobile-Link)

**Tasks**

1. Determine the vital capacity in litres using a spirometer.
2. Create a spirogram from the recorded measured values.

## Equipment

Experiment with iPad or Android tablet

Position No.	Material	Order No.	Quantity
1	Cobra4 Wireless/USB-Link incl. USB cable	12601-10	1
2	Cobra4 Sensor-Unit Spirometry, Pulmonary volume and Wind Speed	12675-00	1
3	Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)	12675-11	1
4	USB charger for Cobra4 Mobile-Link 2 and Wireless/USB-Link	07932-99	1
Additional material:			
	Android-Tablet or iPad		1
	PHYWE measure App		

Android

iPad



Experiment with PC

Position No.	Material	Order No.	Quantity
1	Cobra4 Wireless/USB-Link incl. USB cable	12601-10	1
2	Cobra4 Sensor-Unit Spirometry, Pulmonary volume and Wind Speed	12675-00	1
3	Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)	12675-11	1
4	USB charger for Cobra4 Mobile-Link 2 and Wireless/USB-Link	07932-99	1
5	Software measureLAB	14580-61	1
Additional material:			
	PC		1

## Warning information

### Warning

The apparatus used is not a medical measuring instrument. The measured values obtained with it are only to be used to provide an understanding of spirometry. Deviations in measured values between students, or from the values given in the figures which are used here as examples, are not to be considered to be a pointer to a possible illness. A pulmonary function test which is carried out by a physician is the only means of obtaining a medically relevant diagnosis.

### Notes on the procedure

Make sure that the students carry out the experiment in the standing position, as this is a necessary condition of the experiment. The behaviour of the lungs with regard to volume is namely different when sitting to when standing. Should some students stand up and others sit down, this would cause an unnecessary difficulty in comparing the values for different tested students.

Further to this and for reason of hygiene, ensure that each student uses an unused, originally packaged cardboard mouthpiece and a new FlowMir turbine for the experiment.

Please make it clear to the students how they are to breathe in and out for the determination of the various measured values should this not be clear to them from the text.

# Direct determination of lung volume from a spirogram

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## Introduction

### Principle and task

#### Key words

Spirogram, Vital lung capacity

#### Principle

The lung is the organ which plays a decisive role in the exchange of gases with the surroundings. The membrane with which the lung is lined releases  $\text{CO}_2$  from the blood in which it is dissolved and passes  $\text{O}_2$  into the blood. To breathe in, the diaphragm must contract to effect a stretching of the lungs, i.e. diaphragm contraction causes the volume of the lung to increase. Air is hereby drawn into the lungs from the surroundings. The subsequent relaxation of the diaphragm causes the lung to contract back so that air is passively breathed out. This cycle ensures the repeated breathing in of oxygen and breathing out of carbon dioxide. But how many litres of air can we breathe in and breathe out in one breath?

The aim of this experiment is to directly determine the vital capacity, instead of determining it indirectly as in the "How much air can our lungs contain?" experiment. Further to this, the dependency of the volume on time is presented here in the form of a spirogram.



Fig. 1: Using the spirometer to determine various measured values

#### Tasks

1. Determine the vital capacity in litres using a spirometer.
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## Set-up and procedure

### Set-up

- Plug the spirometer unit onto the Cobra4 Wireless/USB-Link unit.
- Take a turbine out from its packaging and insert it into the opening of the spirometer unit with a brief and gentle turning movement.
- Take a new cardboard tube from its original packaging and plug it into the turbine which was previously fitted in position.
- The resulting apparatus should now be as shown in the Figure 1.

### Procedure

The following experiments are all to be carried out in a standing position so that the results of one person can be compared with those of other persons.

- Start PHYWE measure App  and switch on the Cobra4 Wireless/USB-Link. The sensor is detected automatically.
- Select the Cobra4 Sensor-Unit Spirometry in PHYWE measure App . The measurement automatically shows the volume as a function of time.

#### Measurement


- Bring the spirometer mouth piece into your mouth so that it is air-tightly surrounded by your lips. No air is to escape through your nose so pinch your nostrils together if necessary.
- Start the measurement.
- While standing, breathe in and out normally several times.
- Now breathe in as much as you can.
- Press out the greatest possible amount of the previously inhaled air.
- Measure the exhaled volume as vital capacity (VC) in litres.
- Stop and save the measurement.



Fig. 3: Display of the measurement data for determining VC

## Result and evaluation

### Results


1. What is your vital capacity in litres? For this, you can examine the curves using the survey tool .

VC = .....



Fig. 4: Determination of VC

### Evaluation

1. Magnify the part of your graph which depicts the maximum inspiration and expiration with the Zoom tool .

This is the **spirogram**. Which region of the curve results from breathing in (inspiration) and which from breathing out (expiration)?

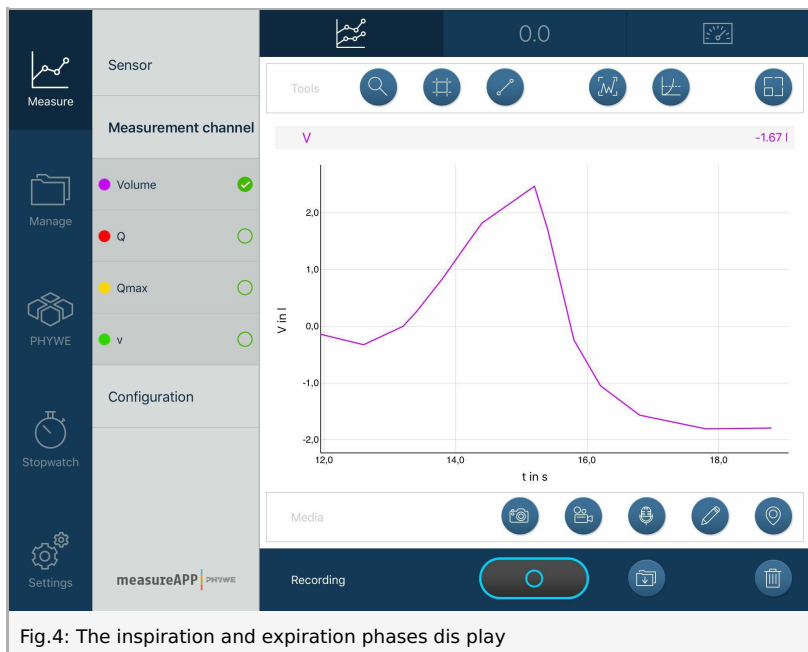


Fig.4: The inspiration and expiration phases display

## Introduction

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#### Principle

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### Procedure

The following experiments are all to be carried out in a standing position so that the results of one person can be compared with those of other persons.

- Start PHYWE measureLAB  and switch on the Cobra4 Wireless/USB-Link. The sensor is detected automatically.
- Select the Cobra4 Sensor-Unit Spirometry in PHYWE measureLAB . All pre-settings required for directly recording the measurement readings are now loaded. The measurement automatically shows the volume as a function of time.


#### Measurement

- Bring the spirometer mouth piece into your mouth so that it is air-tightly surrounded by your lips. No air is to escape through your nose so pinch your nostrils together if necessary.
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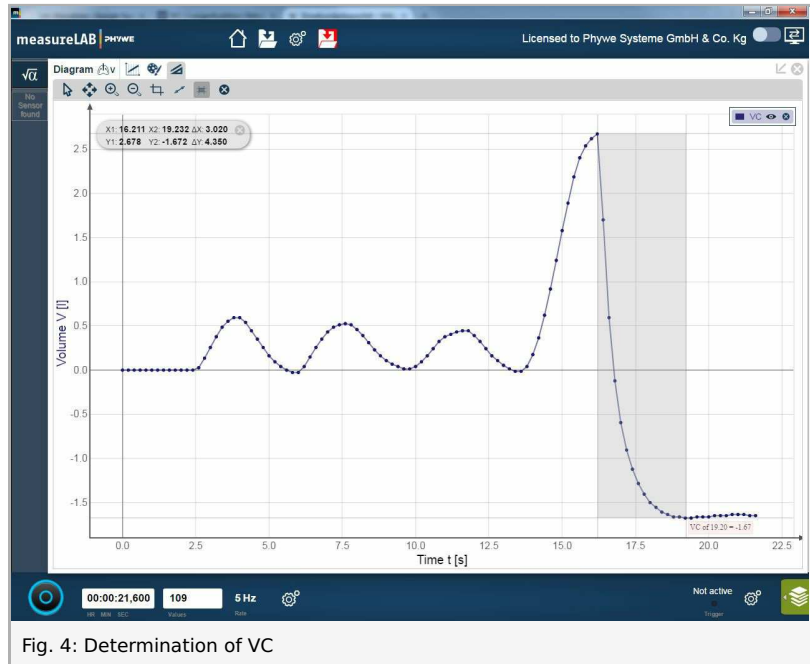


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