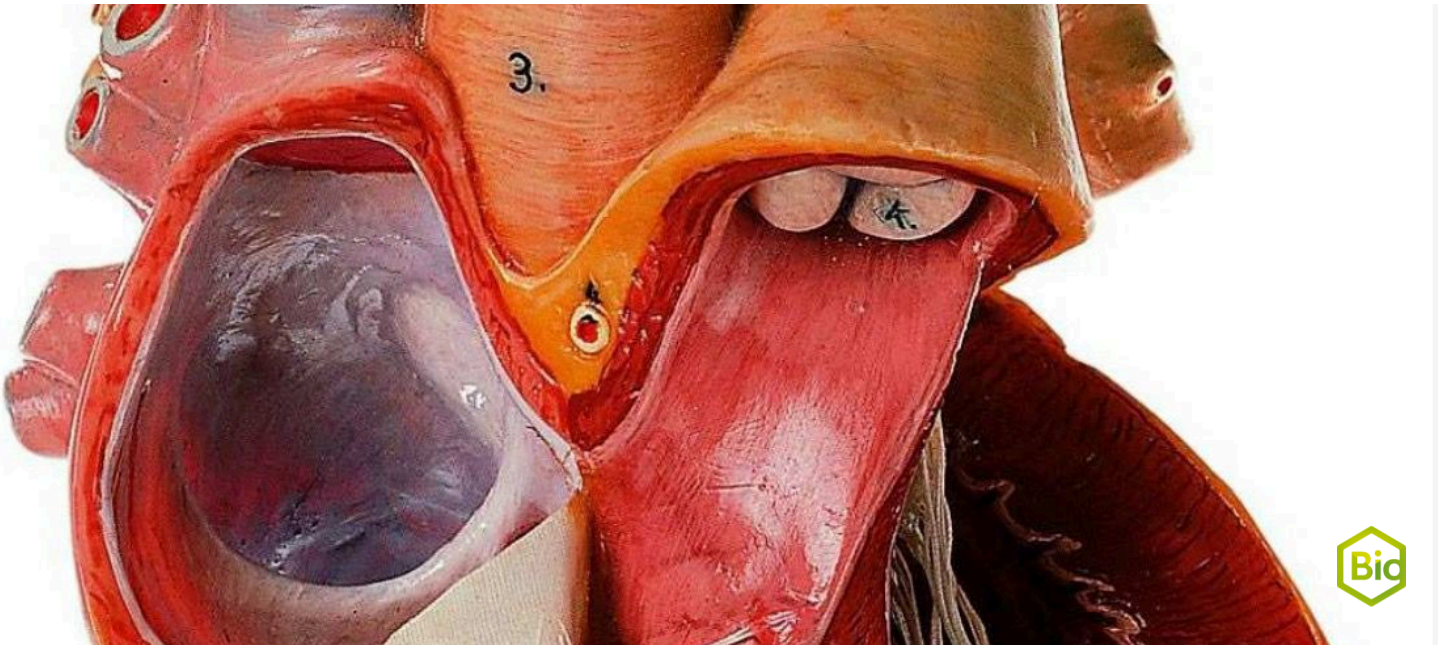
We determine our heart frequency with Cobra SMARTsense



Biology | Human Physiology | Cardiovascular system

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f459db19a658b00033e02f4

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Teacher information

Application

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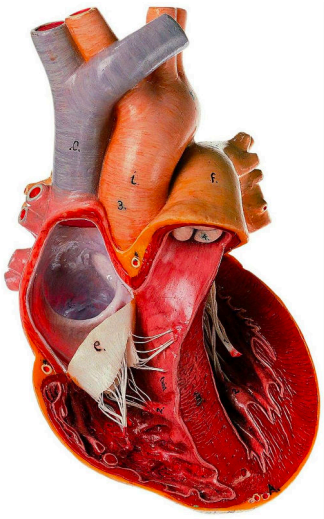

Heart model

The curriculum includes a wide range of topics dealing with the human body. This includes knowledge of the structure and function of important organ systems, an understanding of the own body, its health, cardiovascular system and its diseases, as well as experiments on the function of the eye and the transmission of stimuli.

The heart rate measurement experiment can be performed in isolation or as part of the Cobra SMARTsense electrophysiology kit, which can also be used to perform other non-invasive measurements of heart and muscle activity. By measuring with a tablet or PC, it can be easily integrated into a variety of learning situations, from the classroom to the sports field.

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Other teacher information (1/3)

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Prior knowledge

The level of the heart rate at rest is related on the one hand to the size of the heart in relation to the remaining body volume. A relatively small heart (e.g. an infant) must therefore beat more frequently in order to pump the same amount of blood through the circulatory system. On the other hand, the heart muscle can be trained. In a person with a relatively large and strong heart muscle (e.g. endurance athletes), correspondingly fewer heart contractions are necessary to maintain the stability of the cardiovascular system. Endurance athletes therefore generally have a lower heart rate at rest than untrained people. A resting frequency of 30-35 heart contractions per minute is quite possible.

In the animal kingdom, the correlation is particularly clear: the heart of a mouse beats on average 600 times per minute, whereas in an elephant it contracts only 15-30 times over the same period. Heart rate variability is an expression of the various regulatory mechanisms of the body that are necessary to maintain the stability of the cardiovascular system.

Other teacher information (2/3)

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Prior knowledge

Attention: The correlation of age dependency and average heart rate per minute at rest shown in Table 1 in the protocol should only be considered as a generalizing example. The simple conclusion that heart rate decreases with age is not correct.

Scientific principle

The heart rate is measured by means of electrodes that are attached to different parts of the subject's body. These then transfer the electrical pulses to the Cobra SMARTsense measurement device and the measured values can be read in the PHYWE measure app.

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Other teacher information (3/3)

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Learning objective

The aim of this experiment is to familiarize students with the principle of electrocardiography and to show them the relationships between heart rate, body size and age.

Tasks

1. Create an electrocardiogram of your heartbeat at rest and calculate your heart rate at rest.
2. Table 1 in the protocol shows the heart rate of people in different age groups. Describe the age-related differences in heart rate and compare it to your own heart rate at rest.

Safety instructions

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- **When using, pull out the plug!**For safety reasons, the Electrophysiology sensor unit may only be used if the Cobra SMARTsense measuring device connected to it is not connected to the mains voltage!
- An ECG recorded at school should not be overinterpreted if there are deviations from the exemplary ECG in the illustrations. Circulatory disorders or damage to the heart muscle can only be determined with certainty by a doctor.
- **Note on implementation:**Make sure that the students make sure that the test person does not move during the measurement in the rest position. Even small movements, such as raising a hand, will cause the heart muscle activities to overlap during the measurement.

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Student Information

Motivation

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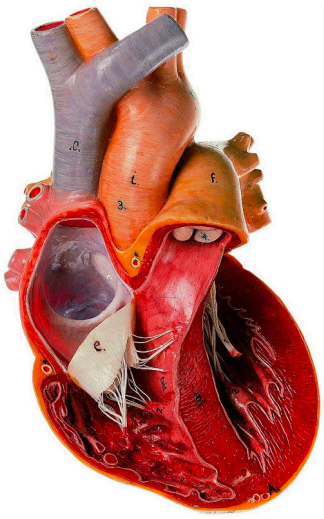

Heart model

We determine our heart rate

With the help of an electrocardiogram (ECG) you can follow the regular sequence of heart contractions and determine your heart rate by determining the time interval between two heart contractions. In a second experiment, you measure the heart rate of test persons of different ages and can prove that during the course of the person's body growth, his average heart rate changes at rest.

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Tasks

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Measured values of an ECG

1. Create an electrocardiogram of your heartbeat at rest and calculate your heart rate at rest.
2. Table 1 in the protocol shows the heart rate of people in different age groups. Describe the age-related differences in heart rate and compare it to your own heart rate at rest.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - EKG, 0 ... 4,5 mV (Bluetooth + USB)	12934-01	1
2	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (1/4)

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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 (2/4)

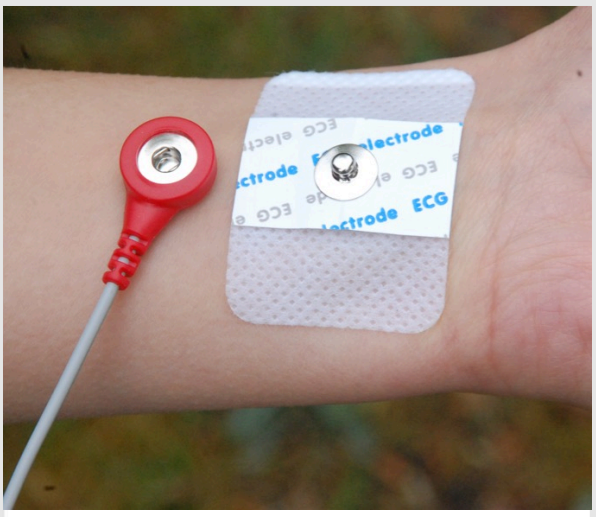
PHYWE

Preparatory measures

Preparation and application of the disposable electrodes

The heart and muscle activity is measured at the skin surface. For each organ you measure at different skin positions.

To get started, the disposable electrodes are best suited because you can simply stick them on the skin positions mentioned in the experiment descriptions without any additional accessories and they will give acceptable results. For measurement, attach the disposable electrodes to the color-coded individual test leads via the push-button system (see figure on the right).



Push-button system

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Set-up (3/4)

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Correctly applied electrodes

- At least two people are involved in the test setup. One test person to whom the electrodes are applied and one person who operates the computer/tablet.
- Attach one disposable ECG electrode each with the adhesive side to the inside of the right and left wrist and to the left ankle. The test person should now sit down in as relaxed a position as possible.

Set-up (4/4)

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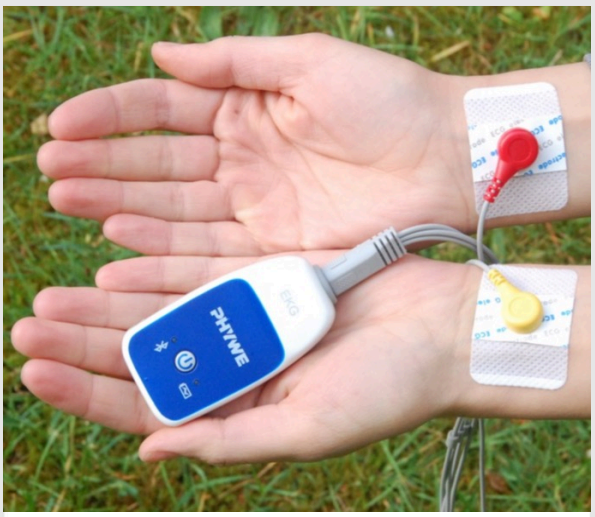
- Now connect the color-coded individual measuring leads to the electrodes: The red push button to the electrode on the right wrist, the yellow push button to the electrode on the left wrist and the green push button to the electrode on the left ankle.
- Now you can connect the electrode collection cables to the Cobra SMARTsense electrophysiology. To do this, simply plug the wide cable end with AUX connector into the top of the device.



Correctly connected measuring instrument

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Procedure (1/3)

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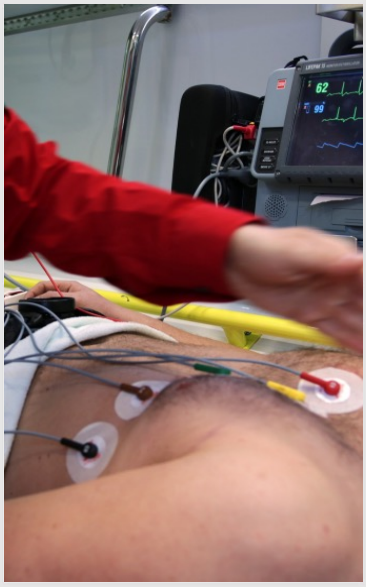

- Now switch on the Cobra SMARTsense sensor.
- Connect the tablet or smartphone to the Cobra SMARTsense via Bluetooth
- Open the PHYWE measure app and select the sensor "Electrophysiology". Select the sensor mode "ECG".
- Select the sampling rate of your choice. The higher the sampling rate the more accurate the measurement. Additionally there is the possibility to multiply values by a factor to get a clearer picture. To do this, simply select a factor at "Gain".

Procedure (2/3)

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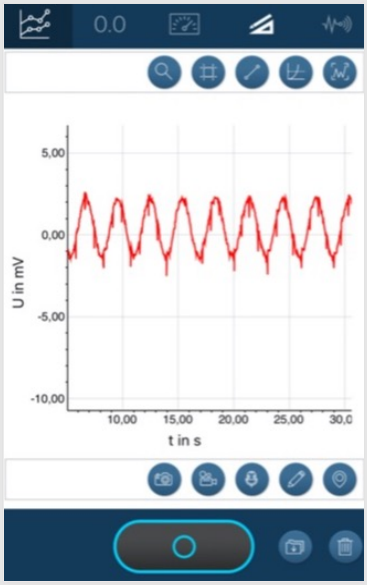

- Start the measurement when the voltage has levelled off. It is important that the test person remains completely still during the measurement, otherwise other muscle activities will be recorded.
- After about one minute you will have enough data to determine your heart rate and you can stop the measurement and then use the zoom tool and fitting tool to have the graph displayed appropriately.
- On the left you can see what your measurement result could look like.

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Procedure (3/3)

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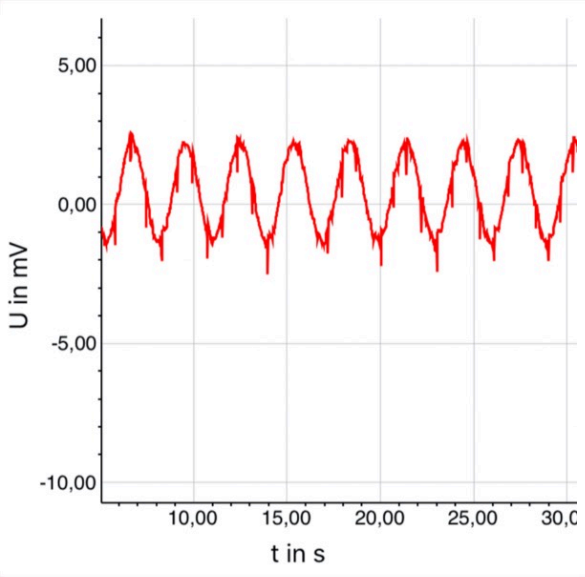

- Select a suitable section of the measurement after completion of the measuring process (see figure on the left).
- With the "Zoom" function a suitable section of the measurement can be selected and evaluated with the "Measure" function.
- To eliminate the phenomenon of heart rate variability between the individual heartbeats, calculate the average of 10 heart contractions.

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Report

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Table

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Age	Average heart rate at rest
Infant	Approx. 120-140 contractions per minute
10-year-old child	Approx. 80-100 contractions per minute
Adult	Approx. 60-80 contractions per minute

Table 1: Average heart rates of different age groups.

Task 1

PHYWE

In Table 1 on the last slide, the dependence of age and average heart rate is shown as an example.

Compare your heart rate at rest with the chart and make assumptions about the causes of age-related differences in heart activity.

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Task 2

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What is the heart rate at rest in beats/min (beats per minute)?

What is the time interval between two heart contractions?

Task 3

PHYWE

Stethoscope and ECG

Determine the heart rate variability for 10 consecutive heart contractions and document the smallest and largest value.

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Task 4

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Mouse

What is the average heart rate of a mouse?

600 beats per minute

15-30 beats per minute

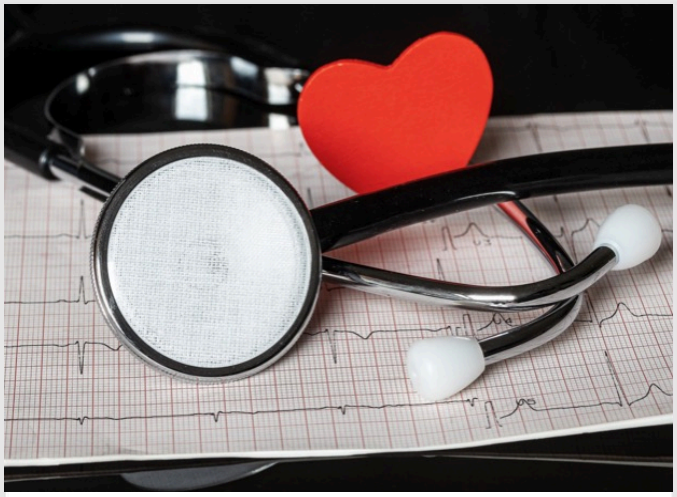
Task 5

PHYWE

The heart rate variability is the same as the heart rate.

○ True ○ Wrong

Check



Stethoscope and ECG

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Task 6

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Measured values of an EGK

An EKG measures:

- ○ The velocity of the bloodstream.
- ○ The movement of the wrists and ankles.
- ○ The electrical voltage changes at the heart.

Check

Slide	Score / Total
Slide 23: Heart rate mouse	0/2
Slide 24: Heart rate variability	0/1
Slide 25: ECG	0/1

Total amount 0 / 4

Solutions Repeat Exporting text

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