Measuring weight force with Cobra SMARTsense

In this experiment, students recognize the proportionality between weight force and attached masses (Hooke's law) through their own measurements.

Nature & technology > Devices & machines in everyday use

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

This content can also be found online at:

http://localhost:1337/c/6056522ca302c500039bf9dd

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Teacher information

Application

Experimental set-up

In this experiment, students observe the measured force on the Cobra SMARTsense force sensor through different attached masses.

On the one hand, they find that the weight force of the attached masses increases with the increase in mass and, on the other hand, that the force effect is reversible. From the measurement results, they conclude that the weight force is proportional to the attached mass; they thus already learn the basics of Hooke's law.

In addition, they learn how to handle the SMARTsense force sensor, understand the relationship between indicated force and attached mass and can apply this knowledge in the following experiments.

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Other teacher information (1/2)

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Prior knowledge

It is important to introduce the term "mass" instead of "weight" in order to avoid confusion with the "weight force".

The unit of measurement of the force 1N should be known and applicable

Students should be able to describe proportional correlations using Hooke's law as an example.

Scientific principle

In this experiment, students should identify the proportionality between weight force and attached masses through their own measurements (Hooke's law).

Furthermore, they should practice using the SMARTsense force gauge.

Other teacher information (2/2)

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Learning objective

The weight force increases proportionally with the increase of the mass.

The force effect is reversible.

Tasks

- Students become familiar with the use and adjustment of the Cobra SMARTsense force sensor and are given enough time to understand how it works and operates.
- Students measure the weight force for different masses.
- They consider what the correlation is between the mass and the displayed force.

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Safety instructions

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- Before carrying out the test, students should be warned to handle the SMARTsense force sensor with care.
- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

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Motivation

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Kitchen scales

The force of weight influences our lives every day. It not only ensures that it is harder to carry a full school bag than an empty one or whether you are allowed to drive over a bridge with a heavily loaded truck, it is also important in everyday life whenever we want to determine the mass of an object.

It doesn't matter if you want to weigh yourself, figure out the price of that bunch of carrots at the checkout in the supermarket, or need a certain amount of flour and sugar for a recipe.

But how exactly does the scale determine the mass of a body from the weight force?

Tasks

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A bucket is one-third filled with water and you need a certain strength to lift it. Then you fill the bucket completely with water. How much strenght do you need now to lift it?

- about three times the strenght
- about the same strength
- about twice the strength

How does the force displayed on the SMARTsense force sensor behave with weights attached?

- Adjust the force gauge and familiarize yourself with its operation.
- Hang the weight plate on the force gauge, place further slotted weights on it one after the other and measure the weight force in each case. Make a note of your measurements.
- Consider how the weight force changes in relation to the attached mass.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Force and Acceleration, ± 50N / ± 16g (Bluetooth + USB)	12943-00	1
2	Weight holder, 10 g	02204-00	1
3	Slotted weight, black, 10 g	02205-01	9

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Set-up (1/3)

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 (2/3)

Cobra SMARTsense force gauge

Preparation:

In this experiment you will get to know the Cobra SMARTsense force sensor. You can record the readings with the "measure App".

Turn on the sensor and open the "measure App". Select the force sensor there ("SMARTsense - Force 50N").

Go to the window with the analog display (the scale with the needle). If you now pull on the hook, you can see the force you are pulling with.

The force is given in the unit "Newton", after a number simply abbreviated as "N".

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Set-up (3/3)

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Cobra SMARTsense force sensor

Adjust the force sensor ("Adjust"):

When you open the "measure App", the force sensor will always show you "0 N" at the beginning.

When opening the app, already hold it so that the hook is facing down.

If it shows a value other than "0 N", you can correct the value. To do this, go to "Settings" and then to "Set to zero". Select the channel and save.

Procedure (1/2)

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Fig. 1

Take the force sensor in your hand and hold it so that the hook points downwards, as in Fig. 1. The display should read "0 N".

In the measure app, set "Measurement at keystroke" and go to the diagram window.

Take a reading with the app.

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Procedure (2/2)

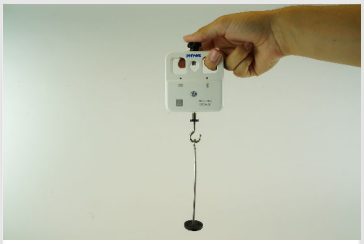

Fig. 2

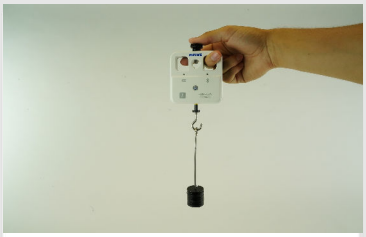

Fig. 3

Hang the weight plate on the hook of the force sensor as shown in Fig. 2, making sure that you hold the force sensor as straight as possible.

Observe the measuring points in the app. Has the value changed due to the attached weight plate?

Take a new reading.

Now place the slotted weights on the weight plate one after the other until finally all weights are on the plate (Fig. 3).

Watch the display and take a new reading each time.

Report

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Task 1

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The unit of force, which is abbreviated as "N", is

- Newton
- Newman

Task 2

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Explain the correlation between the attached mass and the weight force.

The force sensor measures a _____ force when I add more masses and a _____ force when I remove the masses. So the force effect is _____.

If you put more and more _____ masses on the plate one after the other, the acting weight force becomes _____ by the same value and the force sensor shows a _____ value.

So the weight force is _____ to the attached mass.

greater | greater | smaller | proportional | equally heavy | reversible | higher

Check

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Slide	Score / Total
Slide 8: Lifting power	0/1
Slide 16: laws of forces	0/5
Slide 17: Relationship between mass and weight	0/7

Total 0 / 13

Solutions Repeat

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