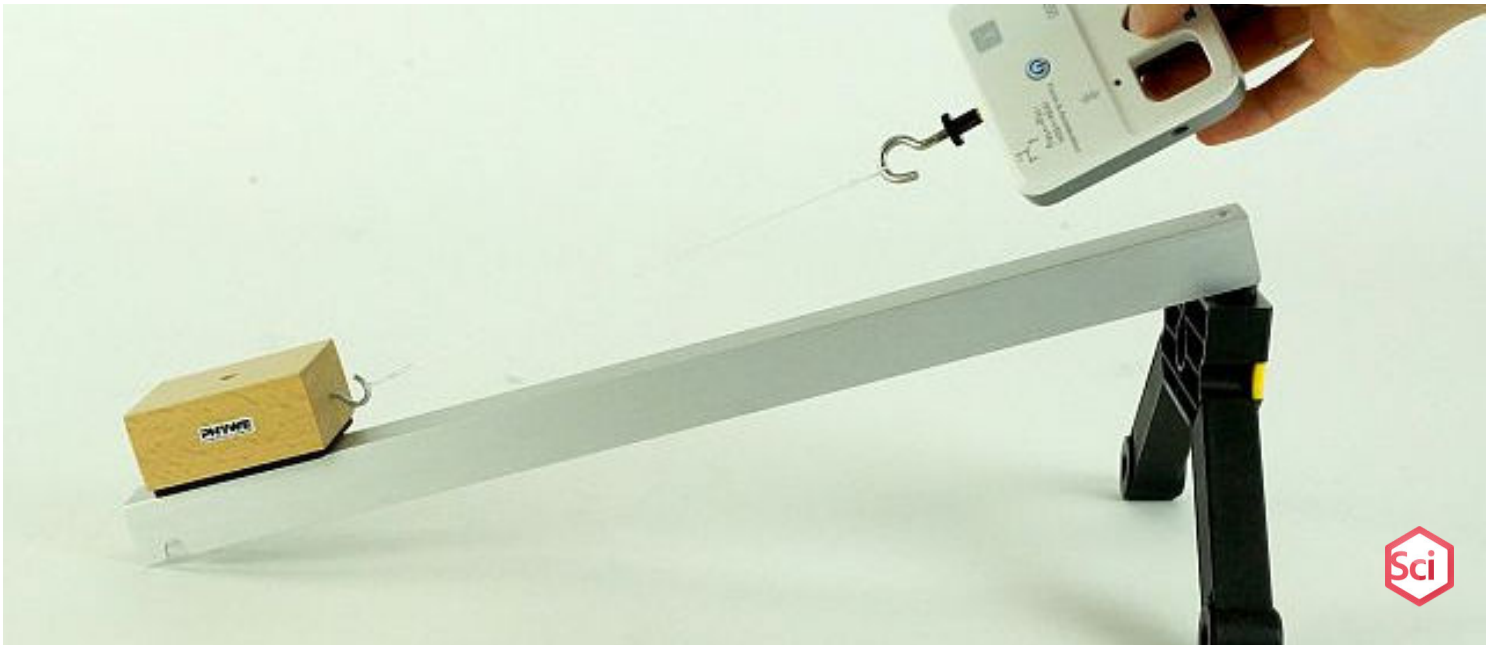
Pulling instead of lifting with CobraSMARTsense



The students observe the force to be applied when transporting a mass. They notice that the process can be carried out with less force if the mass is not lifted freely but pulled across an inclined plane.

Nature & technology > Devices & machines in everyday use

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

This content can also be found online at:

http://localhost:1337/c/63a252aa448618000362c328

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Teacher information

Application

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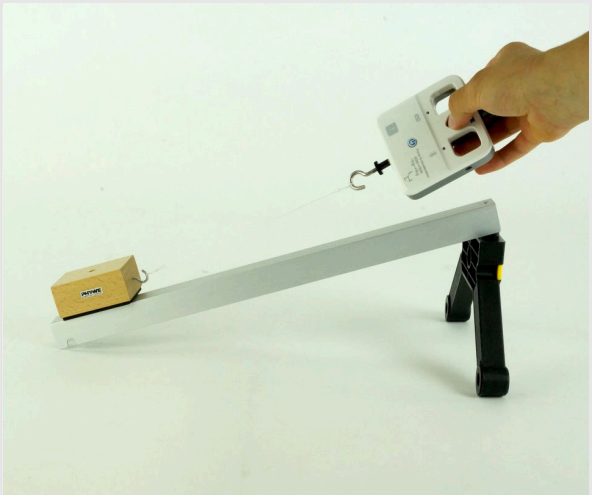

Experimental setup

Loads do not always have to be lifted directly upwards. Often you use an inclined track for this.

In this experiment, the students observe the force to be applied when transporting a mass.

They find that the process can be performed with less force if the mass is not lifted freely but pulled across an inclined plane.

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Other teacher information (1/2)

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Prior knowledge

- The term "mass" should be known and that it is used in science lessons instead of "weight".
- "Mass" is understood here for simplicity's sake as what can be measured in kg or g on the scales.

Principle

- In this experiment, the students realise that the force required to transport a load can be reduced by using suitable aids.
- However, this is only achieved by lengthening the distance over which the force must act. Consequently, the resulting work is (at least) the same. Ask your students if they recognise this "disadvantage" of the new method.

Other teacher information (2/2)

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Learning objective

- In this experiment, the students realise that by lengthening the distance over which the force must act to transport a load, the force to be applied can be reduced.
- The students also realise that the resulting work is (at least) equal.

Tasks

- Measurement of the force required to slowly lift a friction block upwards.
- Measurement of the force required to pull the friction block up an inclined ramp to the same height.
- Comparison of the two force measurements.

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Safety instructions

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

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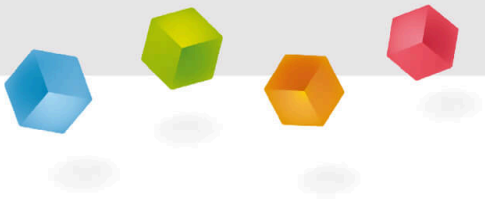

Student information

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Motivation

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Coal transport via a conveyor belt

Have you ever walked up a lot of stairs or climbed the wall bars in the gym?

Then you must have noticed that it can be really exhausting. Taking yourself or even loads to a higher place requires much more strength.

Loads do not always have to be lifted directly upwards. Often you use an inclined track for this:

On the left you see coal coming out of a mine. The coal travels on a conveyor belt diagonally out of the tunnel to the surface.

Tasks (1/2)

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- In this experiment, you investigate two ways to move a block from the table to an elevation.
- First you lift it straight up, then you pull it over a sloping ramp.
- Compare the force you need to bring the block to the target in each case.
- Before you start the experiment, think about why roads in the mountains have so many curves.
- Note down your observations and answer the questions in the report.

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Tasks (2/2)

Serpentine road in the mountains

Look at the curvy road in the photo. Why wasn't the road made shorter?

- ○ So that tourists can enjoy the beautiful mountain landscape for longer.
- ○ To reduce the amount of force required.
- ○ To avoid traffic jams.

Check

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
2	Student set Electric motor / Generator, TESS advanced Physics	15221-88	1
3	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-01	1
4	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-01	1
5	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Structure (1/2)

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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 (2/2)

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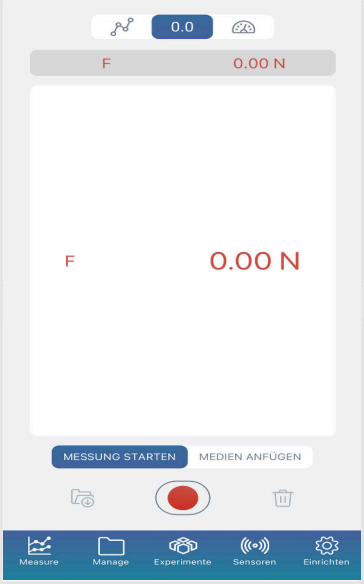

- Switch on your Cobra SMARTsense Force Sensor.
- Open the "measure" app and select the force gauge as the sensor.
- Hold the dynamometer with the hook pointing downstairs and select the item "Set to zero" in the tab "Sensors".
- Go to the "Live Measurement" mode.
- The current load of the Cobra SMARTsense-Force sensor is shown in N on the display.
- With the red button you can record the measurements.

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Procedure (1/3)

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Measurement of the weight force of the friction block

- Place half a tripod base upright with the two round feet on the table so that a platform is formed at the top.
- Place the friction block on the table with the hook facing upwards and hang the dynamometer.
- Start the measurement and slowly lift the friction block upwards with the force gauge and place it on the platform.
- Stop the measurement.

Procedure (2/3)

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- Consider the force required for lifting and record it in the log.
- Now place the magnetic roller conveyor at an angle with one side on the stand base and insert the pin at the end of the conveyor into the tube of the platform. This way you get a stable ramp.

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Procedure (3/3)

- Now bring the friction block back up to the top of the platform.
- This time, place it with the wooden side on the lower part of the ramp and pull it upwards with the force gauge.
- Start the measurement at the bottom and stop it again at the top.
- Consider the force measured when pulling up and record it in the report.

Report

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Task 1

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Observations

Note the force measurements for both ways of moving the block from the table to the platform.

Task 2

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Pulling the friction block onto the platform via the inclined stomach roll track requires...

- ○ more force than lifting the block directly onto the platform.
- ○ less force than lifting the block directly onto the platform.
- ○ just as much force as lifting the block directly onto the platform.

Check

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Task 3

Which of the following are units of measurement for mass m ?

- [ ] kg (kilogram)
- [ ] Pa (Pascal)
- [ ] N (Newton)
- [ ] t (ton)

Check

Task 4

Complete the paragraph!

In order for an object to move, a _____ must act on it. Friction is a _____ that is created on the contact surface of the object and its base when we pull the object over it. The friction counteracts the _____. However, when we lift an object freely into the air, the _____ counteracts the pulling force. The weight force results from the _____ of the object and the acceleration due to gravity.

mass
pulling force
weight force
restraining force
pulling force

Check

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Slide	Score / Total
Slide 9: Initial question serpentine road	0/1
Slide 18: Exertion of force	0/1
Slide 19: Units of mass	0/2
Slide 20: Pulling instead of lifting	0/5

Total 0 / 9

Solutions | Repeat | Export text

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