Force and counterforce with Cobra SMARTsense

In this experiment, the students observe the effects of the action-reaction law. They notice that two connected force sensors always display the same force.

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/60565f9ca302c500039bfa13

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Teacher information

Application

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Experimental set-up

In this experiment, students observe the effects of the action-reaction law.

In doing so, they find that two interconnected force sensors always indicate the same force. To do this, they combine the observation of the analogue spring force gauge with the digital measured values of the "Cobra SMARTsense force sensor" in the "measure app".

From this they conclude that when a force is applied, an equal counterforce is applied to keep the system in equilibrium.

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Other teacher information (1/2)

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Prior knowledge

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

Students should be able to handle and adjust an analogue spring gauge and the Cobra SMARTsense force sensor.

Scientific principle

By using two different force gauges in this experiment, students learn that the forces are identical but read differently well depending on how the data is recorded.

Due to the different measuring ranges, they must be careful not to exceed the display range of the spring force gauge.

Other teacher information (2/2)

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Learning objective

In equilibrium, each force causes an equally large counterforce.

The choice of the correct type of measurement recording is important for accurate measurement.

Tasks

- The students preferably work in groups of two and first adjust their force sensors
- Then they observe the behavior of the force sensors when only one of them pulls on their force sensor at a time and when both of them pull on their force sensor at the same time.

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Safety instructions

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- Before performing the test, students should be made aware that a loaded force gauge may snap back when the load is released.
- Students should use the Cobra SMARTsense Force Sensor with care.
- For this experiment, the general instructions for safe experimentation in science lessons apply

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Student Information

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Motivation

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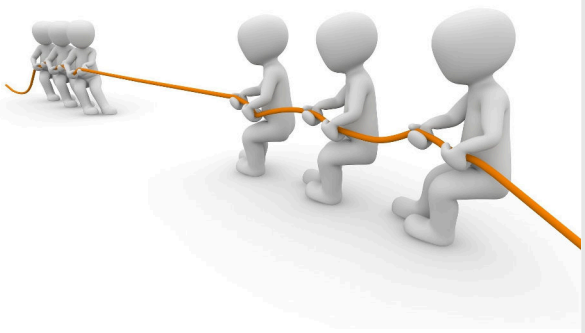

Tug of War

You've probably played tug of war before and noticed that when both teams are about the same strength, the rope barely moves even though both sides are pulling with all their might.

This phenomenon is called the action-reaction law and it states that in an equilibrium, each force experiences an equal opposing force.

Everywhere in our everyday lives, this law plays an important role. Without counterforce, your water glass would simply break through the table and you would fall through the floor into the basement. In order to be able to imagine better, we want to examine the action-reaction law more closely in this experiment.

Tasks

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Think about what's going to happen before the experiment.

If you each pull your force gauge, which one will read a force greater than "0 N"?

- Both force gauges.
- Just the spring gauge.
- Just the Cobra force sensor.

How do a digital and an analog force sensor behave when you connect them and then pull on them?

- Adjusts the two force sensors
- Connect them and check what force they indicate when you pull on one of them and then on both at the same time
- Note what you observe and answer the questions in the report.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Force and Acceleration, ± 50N / ± 16g (Bluetooth + USB)	12943-00	1
2	Spring balance,transparent, 2 N	03065-03	1

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Set-up (1/3)

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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 (2/3)

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Turn on your "Cobra SMARTsense-Force". Open the measure app and select the Cobra SMARTSense-Force 50 N\ sensor if the device does not connect automatically.

Go to the analog display window in the app.

Fig. 1

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Set-up (3/3)

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The experiment works best when you work together as partners.

First, hold your force sensors horizontally and adjust them to "0 N". Then you can hook them together as shown in Fig. 1 so that they form a straight line and display no force.

Fig. 1

Procedure

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1. Have your partner hold their power meter still while you carefully pull yours back a short distance and hold it there. Observe the indicated force on both force gauges. What does the force gauge you pull with show, what does the force gauge your partner holds show?
2. Now hold your force gauge still and let your partner gently pull on his. Again, observe what force is indicated for both force gauges.
3. Now both pull your force gauges at the same time. Try to pull your force gauge so that it reads "1 N". What does your partner's gauge read?

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Report

Task 1

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In an equilibrium, a force acts in each direction.

- true
- false

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Task 2

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Summarize what you learned in this experiment.

If you hook up an analog and a digital force gauge with different _____ and pull on them, they will _____ both show the same force, _____ of whether you pull on only one of them or both at the same time. This can be explained by the fact that in equilibrium, the force always produces an equal _____. On a _____ force gauge, small forces can be read more accurately, and it has a much _____ measuring range than the analog spring force gauge.

measuring ranges
larger
regardless
digital
counterforce
always

Check

Slide	Score / Total
Slide 8: Pull two force gauges	0/1
Slide 15: force and reaction	0/5
Slide 16: Summary - Force and Counterforce	0/6

Total 0 / 12

Solutions Repeat

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