Magnetic attraction (distant effect)

In this experiment, students learn about the effect of magnetic forces in different states.

Physics > Electricity & Magnetism > Magnetism & magnetic field

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/626a500b03522200034b503e

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Teacher information

Application

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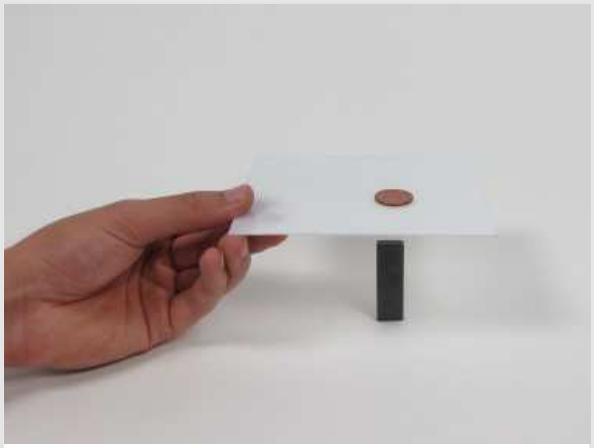

Experiment setup with magnet

Magnetic remote effect

In the case of a long-distance effect, it is assumed that the physical effect takes effect over any distance without a mediating medium and without a time delay. The classical physical theories of mechanics - i.e. Newtonian gravitation, electrostatics and magnetostatics - have a long-distance effect as their basis. This finds exemplary expression in Newton's third law of actio and reactio: two bodies act on each other with oppositely equal forces at any instant, no matter how far apart they are or how they move. In this experiment, students investigate the long-distance effect of magnetic forces.

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Teacher information (1/2)

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Prior knowledge

Students should know that magnets are surrounded by magnetic fields and that magnets interact with other magnets as well as with metallic bodies. In particular, they should know that magnetic metals are attracted to permanent magnets.

Principle

Permanent magnets are surrounded by far-reaching magnetic fields. Therefore, there is a force effect between two magnets even if they do not touch each other. In particular, this force effect becomes greater with decreasing distances and even penetrates non-magnetic materials.

Teacher information (2/2)

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Learning objective

The students should recognize that magnetic forces also act when the magnet and the iron part are not in contact and that the magnetic force decreases with increasing distance and depends on the size of the attracted object. They should also learn that the magnetic effect penetrates substances that are not themselves attracted by the magnet.

Task

Students should investigate whether objects are attracted even when they are not touching, what the strength of the magnetic force depends on, and whether magnets also act through non-magnetic objects.

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Safety instructions

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

Annotation:

The sub-experiments should be limited to qualitative observation. Even a comparison of the different distances at which the objects jump up to the magnet observed in the first partial experiment is difficult to interpret, since both the weight of the objects and the attraction force caused by their dimensions play a role. For the sake of completeness, it would still have to be shown that the magnetic force does not act through sheet iron. For such a partial experiment, corresponding material would have to be procured additionally.

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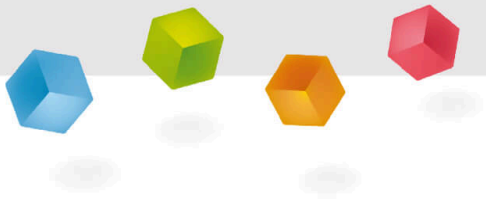

Student Information

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Motivation

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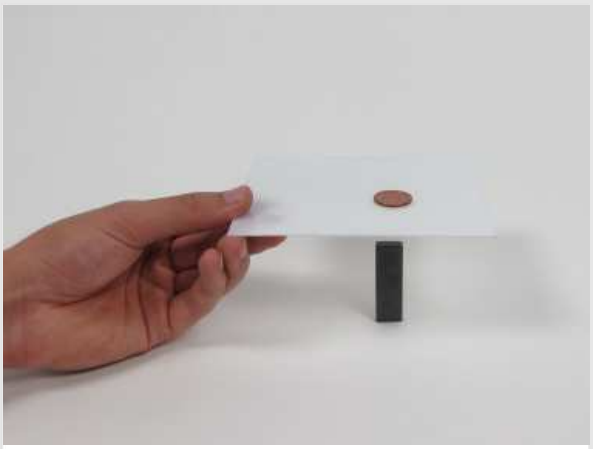

Experiment setup with magnet

You already know that magnets can attract objects made of iron.

- But how do magnetic forces act when the magnet and the iron object are not in contact?
- How does the magnitude of the magnetic force behave at different distances,
- what is it dependent on and
- is there a magnetic effect due to other substances?

We will try to answer all these questions in this experiment.

Task

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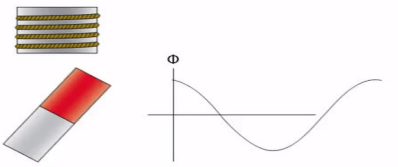
We study the different properties of magnetic force.



- Investigate whether magnets also work through non-magnetic objects.
- Investigate what the strength of the magnetic force depends on.

- Investigate whether objects can be attracted to magnets even when they are not touching.

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Equipment

Position	Material	Item No.	Quantity
1	Conductors/non-conductors,l-50 mm	06107-01	1
2	Polycarbonate plate, 136x112x1 mm	13027-05	1
3	Bar magnet l 50 mm	07819-00	1
4	Pocket compass	06350-10	1

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3	Bar magnet l 50 mm	07819-00	1
4	Pocket compass	06350-10	1

Additional material

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Position	Equipment	Quantity
1	5 cent coin	1
1	Steel paper clip	1
1	Sheet of paper or cardboard	DIN A4

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Procedure (1/3)

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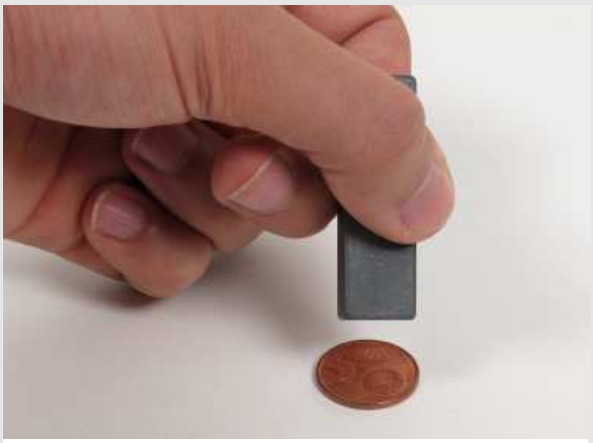

Execution - magnet with 5 cent coin

- Slowly approach one pole of the magnet from above to the 5-cent coin lying on the table.
- Observe the coin.
- Repeat the experiment with the paper clip and with the iron rod and observe the objects in each case.
- Check whether magnetic forces also act over distances of several centimeters. Use a magnet and the compass for this purpose.

Procedure (2/3)

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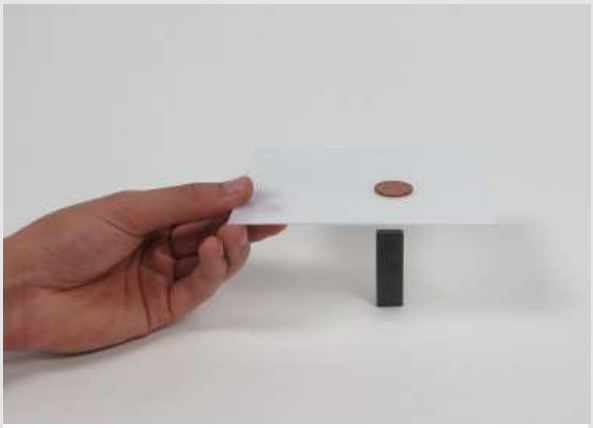

Feedthrough - polycarbonate sheet

- Investigate whether the strength of the magnetic force depends on the iron object attracted.
- Place the 5 cent coin on the polycarbonate plate and bring the magnet from below directly under the coin.
- Lower the plate onto the magnet and raise it again to about 5 cm.
- The magnet should now stick to the plate.
- Then check whether the magnet remains attached to the plate even when it is moved slightly horizontally.

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Procedure (3/3)

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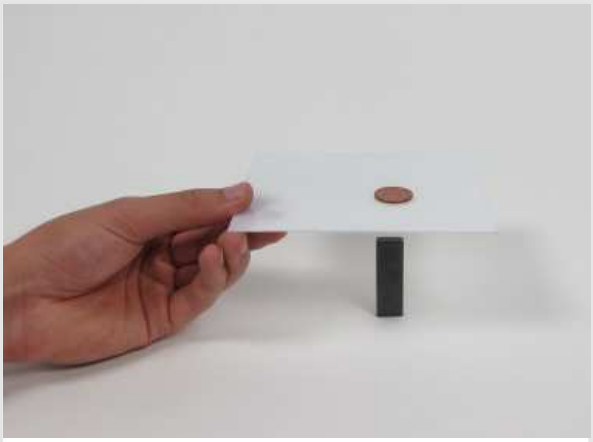

Feedthrough - polycarbonate sheet

- Repeat the experiment, but instead of the coin, the iron rod is on the plate.
- Then investigate whether the magnetic force penetrates non-magnetic materials.
- To do this, hold the polycarbonate plate over the iron parts from the first partial test lying on the table at a distance of about 2 mm.
- Then approach one pole of the magnet from above.
- Repeat the experiment using a sheet of paper or cardboard instead of the polycarbonate sheet.

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Report

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Task 1

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Fill in the missing words.

When the magnet has approached the objects to about [ ] mm, they jump [ ] the magnet.

As the magnet gets closer to the compass, one end of the magnetic needle is turned more and more [ ] the magnet.

Check

What happens to the magnet under the polycarbonate plate when the coin is on top and what happens when the iron rod is on top?

When using the coin, the magnet falls off faster than when using the iron rod.

When using the iron rod, the magnet falls off faster than when using the coin.

Task 2

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Which statements are correct for the magnetic force effect?

- [ ] The smaller the distance between the objects, the stronger the magnetic attraction.
- [ ] The magnetic force is based on a long-distance effect.
- [ ] Even without contact between the magnet and the iron body, the attractive magnetic force is effective.
- [ ] The magnetic force becomes active only when touched.
- [ ] The magnetic force is based on a proximity effect.

Check

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Task 3

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Drag the words into the correct boxes!

The following is true about the dependence of the magnetic force on the size of the attracted object: _____ iron objects are more strongly attracted to a magnet than _____ ones at the same distance. Objects that are not themselves attracted to a magnet do _____ interfere with the attraction between a magnet and an iron body.
Not needed: _____.

larger
not
smaller
essential

Check

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