The electromagnet

Nature & technology > Devices & machines in everyday use

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/6088f7a6c5d4ad0003790beb

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Teacher information

Application

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The electromagnet

The students investigate the behaviour of a current-carrying conductor wound around an iron core (stainless steel rod).

They observe that the structure exerts a magnetic attraction on ferrous objects.

Furthermore, observe that this behavior is due to the combination of the coil and the iron core, since both parts, considered separately, have no or only weak magnetic properties.

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Other teacher information (1/2)

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Previous knowledge

- For this experiment, students should already have basic knowledge about a magnet and its properties.
- This includes, for example, having a north and a south pole and that a magnet can attract and repel objects.

Principle

- A magnetic field is generated by means of a current-carrying coil.
- An iron part in the middle of the coil strengthens the magnetic field and a north and a south pole are formed.
- The magnetic field remains only as long as the current flow is maintained within the coil.

Other teacher information (2/2)

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Learning objective

- The structure exerts a magnetic attraction on ferrous objects.
- This behaviour is caused by the combination of coil and iron core, because both parts separately show no or only weak magnetic properties.

Tasks

- Students take a wire and wrap it around a rod of iron/stainless steel.
- You let electric current flow through the wire and observe how it affects other objects.

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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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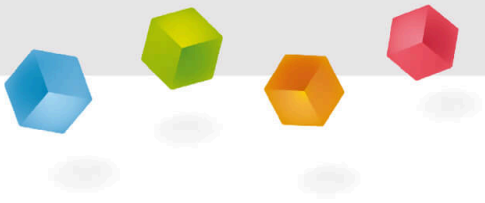

Student Information

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Motivation

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Electromagnet in the junkyard

Electromagnets are often used in everyday life. Mostly when you only want to magnetically attract objects for a short time:

- The lifting magnet: Often found in the scrap yard to lift iron parts and place them elsewhere.
- The fire door: The doors are held open by a magnet. If someone triggers the fire alarm, the magnet switches off and the doors close by themselves.
- When sorting rubbish: objects made of iron are separated from other rubbish with a magnet.

Tasks

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- Take a wire and wrap it around a rod of iron/stainless steel.
- Let electric current flow through the wire and observe how it affects other objects.
- Before you start the experiment, consider whether a wire through which current flows acts like a magnet.
- Note down your experimental observations and answer the questions in the protocol.

An electric current flows through a cable. What do you think, does the cable act like a magnet?

No, the cable has no effect on objects such as iron.

Yes, the current causes the cable to attract objects like iron.

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Equipment

Position	Material	Item No.	Quantity
1	Flat battery, 4.5 V	07496-01	1
2	Connecting cord, 32 A, 250 mm, black	07360-05	3
3	Alligator clip	167700	4
4	On/off switch for sciences sets	09390-07	1
5	Conductors/non-conductors,l-50 mm	06107-01	1
6	Jumper wire, isolated, 1m	330790	1

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Set-up (1/3)

- Set up the experiment as shown above left.
- **Make sure that the on/off switch is turned off before connecting the battery.**
- To do this, move the lever upwards as shown in the figure below left. This ensures that no current flows through the circuit. Set the switch only during the measurement and switch it off again afterwards.
- **Only change the setup when the on/off switch is turned off!**

Set-up (2/3)

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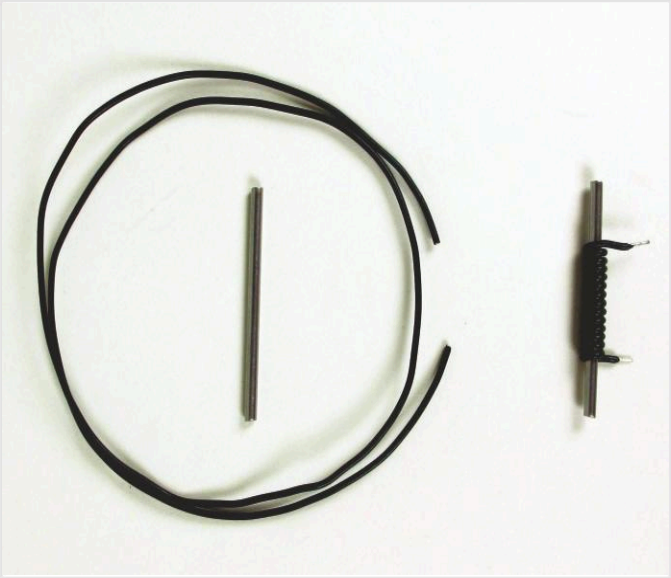
Take a piece of switch wire about 10 cm long.

- Remove a small part of the insulation at both ends. This is important so that the crocodile clips can touch the wire here later.
- Take the stainless steel rod (check with a magnet if you are unsure).
- Wrap the switch wire several times around the stainless steel rod. Make sure that both ends of the wire are free!



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Set-up (3/3)

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Assemble the circuit in the following order:

Battery - On/Off switch - Switching wire (wound on rod) - Battery

Connect the parts with a cable each.

- You can plug the cables directly into the blue module.
- Clamp an alligator clip to the battery terminals and the ends of the switch wire. You can then plug the cable in there.

Procedure (1/3)

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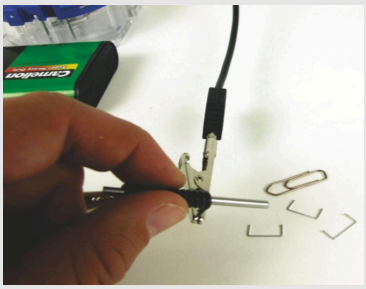

Scatter the paper clips, nails, and other small items around the table.

Take the iron core with the wire wound around one end in your hand. Hold it with the other end against the objects on the table one after the other and observe what happens.

Turn on the on/off switch. The circuit is now closed!

Now hold the stick over the objects on the table again and watch what happens.

Turn the on/off switch off again!

Did anything happen when you turned it off? Write down your observations in the log.

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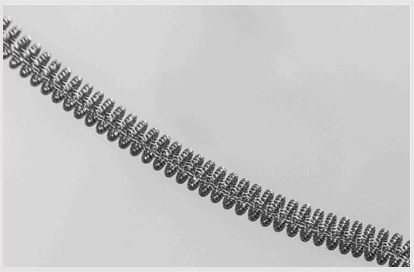
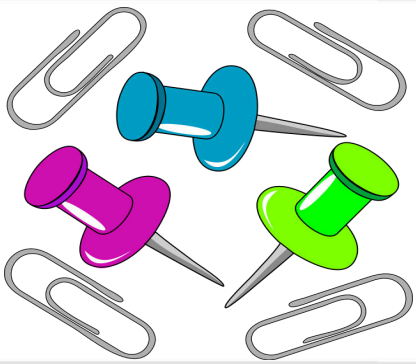
Procedure (2/3)

- Take the rod out of the coiled wire.
- Turn on the on/off switch. The circuit is now closed!
- Hold the wire wound into a coil over the objects on the table.
- Turn the on/off switch off again!
- Is the behaviour of the coil different without the rod? Write down your observations in the protocol.



Procedure (3/3)

Hold the single stick over the objects on the table and watch what happens.



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Report

Task 1

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From which metals can magnets be made?

- [ ] Aluminium
- [ ] Nickel
- [ ] Iron and cobalt
- [ ] Copper

Check

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Task 2

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The power is on:

How do the wire and the stainless steel rod behave when you hold them individually over the objects?

The wire pulls ...

- ...iron strongly.
- ...iron not on.
- ...iron weak on.

Task 3

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After you have carried out the experiments, answer which of the following statements are correct

Which statement is correct

- A coil in a closed circuit creates an electromagnet
- An electromagnet does not act like a bar magnet
- An iron core reduces the magnetic effect of the electromagnet.

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Task 4

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Where are electromagnets used?

- For waste separation, as aluminium is attracted to magnets.
- For insulating power cables
- In an electric bell

Slide	Score / Total
Slide 8: Opening question	0/1
Slide 17: Structure of an electromagnet	0/2
Slide 18: Wire and stainless steel rod	0/2
Slide 19: The electromagnet	0/1
Slide 20: Application of electromagnets	0/1
Total	**0/7**

Solutions Repeat

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