Electromagnets attract specific metals just as permanent magnets do. However, electromagnets attract those metals only when they are connected in an electric circuit. Therefore, you can turn electromagnets on and off. Electromagnets are used in a lot of technical equipment. For example, large electromagnets are used to lift and load metal-waste. Further, you can find electromagnets in electric motors and in the speakers of your stereo system.

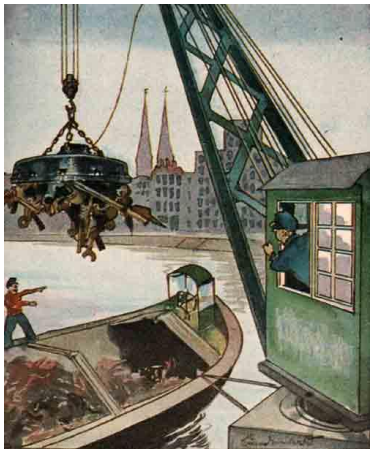


Figure 1 Loading of metal waste with a large electromagnet

Electromagnets are made of a wire that is wrapped to a coil. Often a piece of metal is inside the coil to increase the attracting force of the electromagnet.

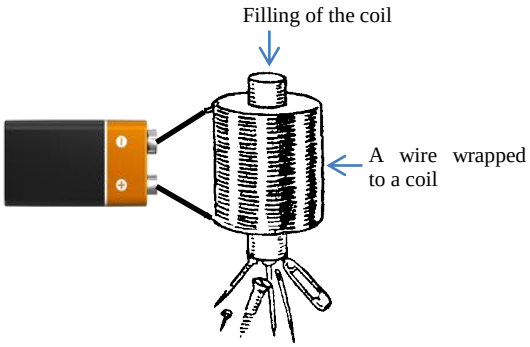


Figure 2 Electromagnet conceded with an battery

In our previous physics lesson we learned how to design valid experiments.

Info-Box

You always have to compare two setups in valid experiments. You have to take care that only the variable you are investigating differs between the two setups. If more than one variable differs between two setups than you can know for sure that differences in your depended variable are caused by the changes in your investigated variable.

Today, you have to use your knowledge about valid experiments to find out on which variables the attracting force of electromagnets depend.

On the following pages it is your job to evaluate experiments designed by other students and to plan and evaluate your own experiments. To plan your experiments you can but you don't have to use all the equipment you find on the equipment list. Please turn the pages only when you are completely done with all tasks on a page.

Good Luck!

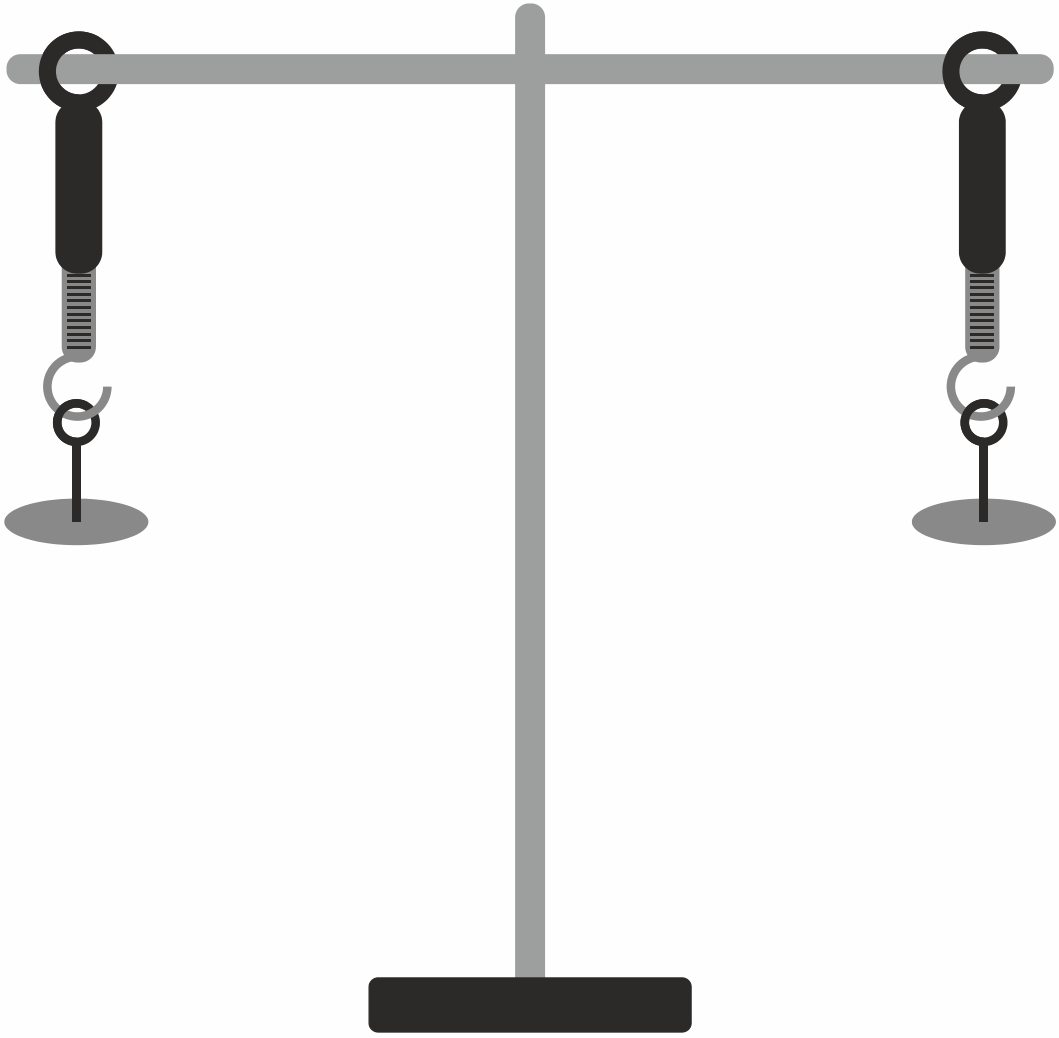
Task 1:

Lea and Marian want to find out whether, the attracting force of an electromagnet depends on the number of times the wire is wrapped around the coil. To investigate that they planed the experiment you see in front of you.

Please look carefully at the experiment and do not change it jet. Unfortunately, the experiment of Lea and Marian is not valid. Please write down all the problems you can find.

What would you change so that the experiment is valid? Pleas draw your alternative design in the draft below and label all the equipment you want to use.

Unser Verbesserungsvorschlag:



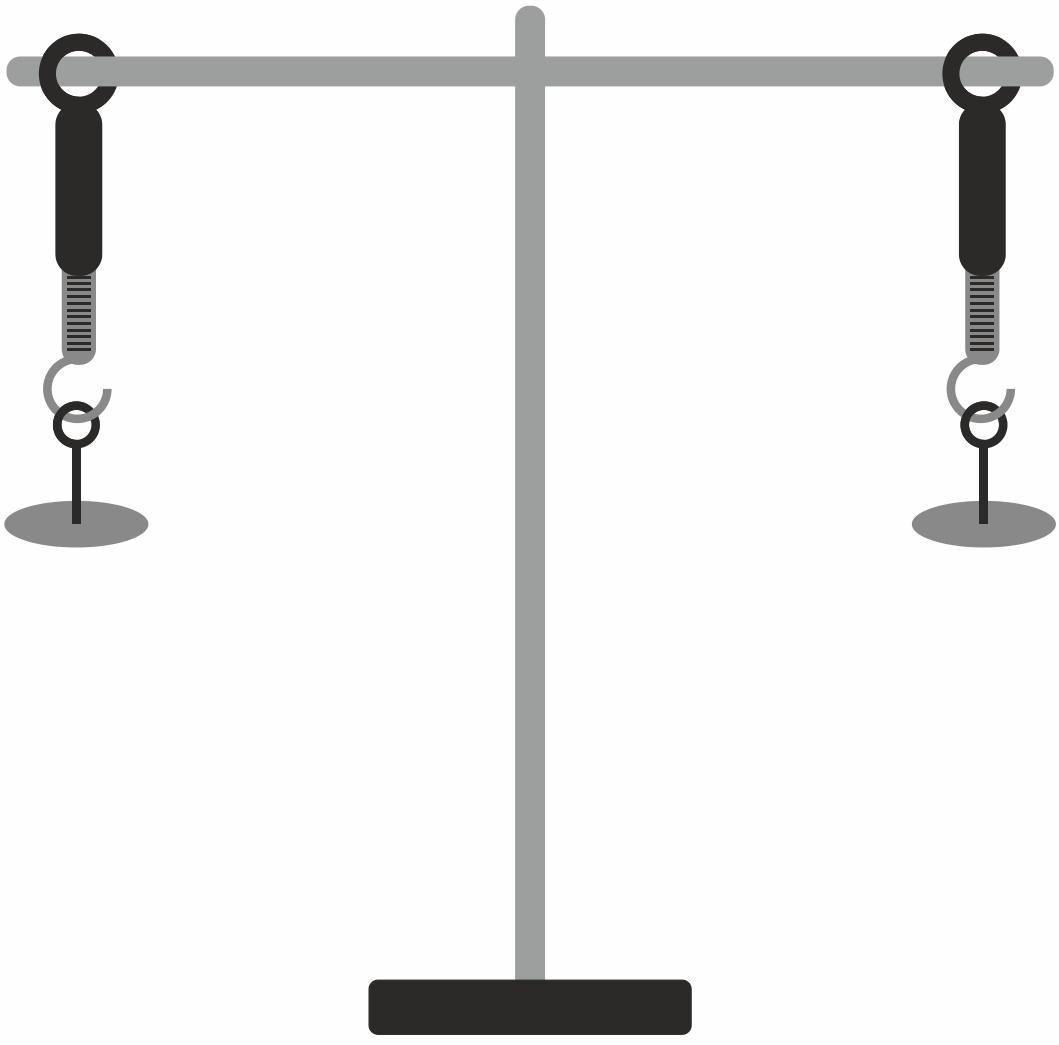
Task 2:

Marian and Lea want to know which additional variables influence the attracting force of electromagnets. They are collecting their ideas.

Lea says: *„I recognized that strong electromagnets have iron inside the coil. I wonder whether the material inside the coil has an impact on the attraction of the electromagnet.“*

Now it is your turn. Designed an experiment to test Leas assumption. Pleas draw your design in the draft below and label all the equipment you want to use. Take notes of all variables and measured data after you have done the experiment.

Our experiment:



Our data and variables:

What did you find out?

☐	Leas assumption is **right**. The force of an electro-magnet depends on the material inside the coil.
☐	Leas assumption is **wrong**. The force of an electro-magnet depends **not** on the material inside the coil.

Pleas think ones again about your experiment. Why can you know for sure that you found something out about the impact of the material inside the coil on the attracting force of electro magnets?

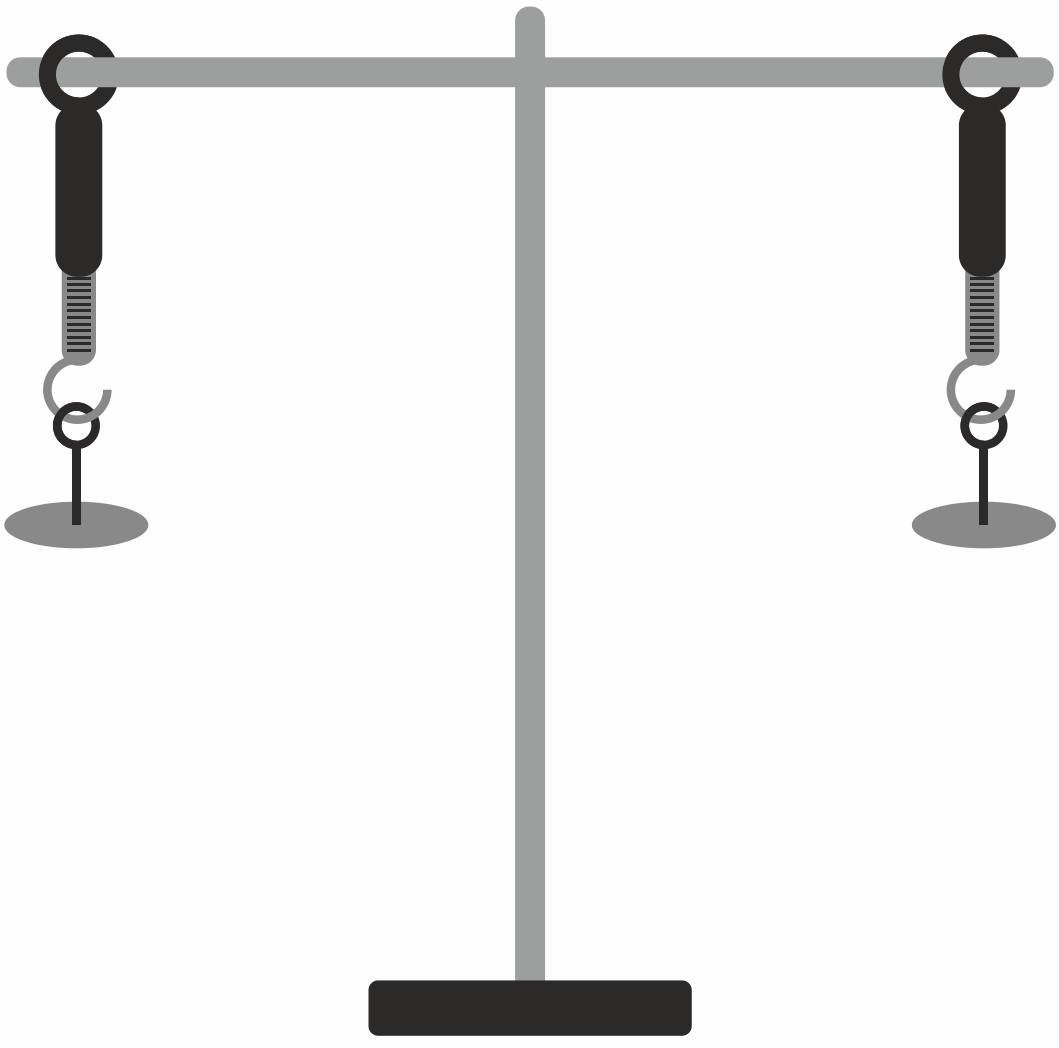
Task 3:

Marian and Lea think about further variables that might influence the force of electromagnets.

Marian says: *„I think, maybe the magnetic effect of electricity depends on the current because I know it is like this with the heating effect of electricity. I assume that electromagnets will be stronger when a they are connected to a higher current.“*

How can you test Marian's assumption? Pleas draw your design in the draft below and label all the equipment you want to use. Take notes of all variables and measured data after you have done the experiment.

Our experiment:



Our data and variables:

What did you find out?

☐	Marian's assumption is **right**. The force of an electro-magnet depends on the current.
☐	Marian's assumption is **wrong**. The force of an elec-tromagnet depends **not** on the current.

Pleas think ones again about your experiment. Why can you know for sure that you found something out about the impact of the current on the force of electromagnets?