5. ELECTRIC CURRENCY AND THE MAGNETIC NEEDLE, or the Oersted experiment;

Short description:

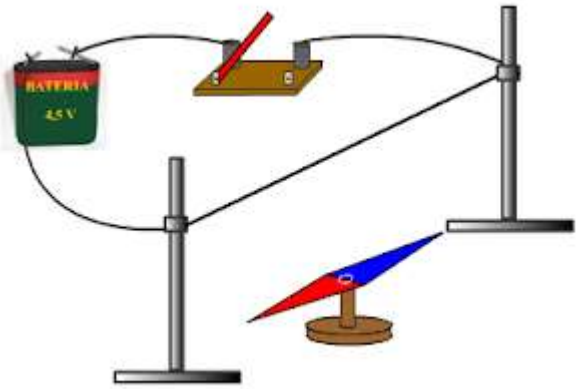
The experiment is an introduction to understanding how electromagnets work and answers the question of whether there is a magnetic field around a conductor with electricity.

Materials:

materials from the box	materials to prepare
⇨ battery; ⇨ cables; ⇨ compass; ⇨ switch;	

Course of the experiment:

- ☞ from wires, switch and battery build a circuit according to the drawing;



Source: https://magnetyzmallinone.blogspot.com/2009/10/doswiadczenie-oersteda.html

- ☞ lift one part of the cable up and rest it e.g. on blocks, glass cups etc. so that you can put a compass under it;
- ☞ check if the switch is open (the circuit is not closed);
- ☞ slide the compass under the raised part of the wire;
- ☞ close the circuit with the switch;
- ☞ observe the position of the compass needle;

Substantive description:

The Hans Ørsted experiment (polonised spelling: Oersted) is an experiment conducted in 1820 by Danish physicist Hans Ørsted. A magnetic needle, positioned under an electric conductor, changes its orientation when an electric current is applied to the conductor, proving that a magnetic field is generated around the conductor. The magnetic needle is nothing more than a lightweight, freely fixed permanent magnet that points in a north-south direction. This is due to its interaction with the Earth's magnetic field. This indication can be disturbed by another magnet producing a stronger magnetic field than the Earth's, as well as by the presence of a conductor in the vicinity of the magnetic needle, in which an electric current is flowing.

Oersted's experiment proceeds as follows: We extend a rectilinear conductor in parallel, just above the magnetic needle, and then connect it briefly to a constant voltage source, such as a flat battery. We observe that as current flows through the conductor, the magnetic needle deflects. When the current in the conductor stops flowing, the magnetic needle returns to its original north-south orientation. Hence, we can conclude that there is a magnetic field around a conductor with an electric current.

After Oersted's discovery, the following question arose: since electricity produces magnetism, is magnetism able to produce electricity? It took more than a decade to answer.

Trivia:

- Oersted began his experiments in the classroom, during a lesson on electricity.
- The needle will point in a direction that is the resultant of two fields – the Earth's and that of a current carrying wire.
- The experiment shows the omnipresence of the Earth's magnetic field. It's worth to notice that neither Mars nor Venus has its own magnetic field. Magnetic fields protect the Earth from the influx of electrically charged particles form the Sun (mainly protons and high-energy electrons) that are harmful to living beings..
- Recent studies indicate that the Earth's magnetic field is used by sea turtles returning to their nesting sites to lay their eggs, and by nightingales flying south from Sweden in winter *(G. Karwasz „Magnetic turtles" na http://modern.fizyka.umk.pl/)*. It is possible that a 'magnetic' sense may also be present among other living beings.

https://dydaktyka.fizyka.umk.pl/Doswiadczalnik2015/Do%C5%9Bwiadczenie%20Oersteda%201.pdf

Intriguing questions:

- Does the direction of the battery terminals make any difference?

Modify the experiment:

- try laying the compass in different positions and continue observing the compass needle;
- try connecting the batteries with the polarity reversed – "the other way round";

Guidelines for trainers:

- before closing the conductor, wait for the needle to point in a north-south direction, then place it under the conductor so that the needle and conductor are parallel to each other – you will be able to see clearly the subsequent swing of the needle.
- "reversed" connection of the battery will cause the needle to swing the other way – you can guide the children's comments so that they themselves suggest alternate connections of the battery terminals;