

Electromagnetic Forces

~Lesson should be completed with adult supervision~

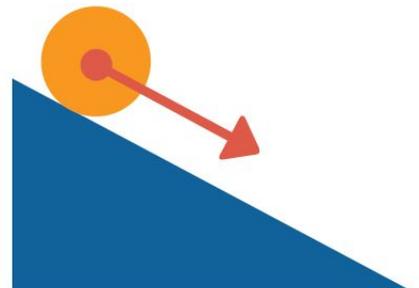
Lesson Description	Materials	Vocabulary
<p>Explore magnetism and design electromagnets to explain the phenomenon: when an electric current moves through a wire, an invisible magnetic force surrounds the wire. Adding a nail to the electromagnet will temporarily magnetize the nail.</p> <p>Lesson Objective Plan and carry out an investigation on electromagnetism, and explore the cause-effect relationship between electricity and magnetism.</p>	<ul style="list-style-type: none"> ● electrical wire (w/ ends trimmed and stripped) <ul style="list-style-type: none"> ○ copper ○ old cords or wires (some wires may create a spark and some smoke - adult supervision and help is suggested) ● batteries (any) ● nail or screw (magnetic) ● lightweight metal objects <ul style="list-style-type: none"> ○ paper clips ○ staples ○ wire 	<ul style="list-style-type: none"> ● electromagnet ● current ● magnetic force ● magnets ● non-contact force

Watch It!

- [Electromagnets: How do they work?](#) This video explains the basics of electromagnets and some common uses.
- [Magnetism for Kids](#) This video explains the basics of magnetism.
- For more information for students, teachers, or families, visit [PEAKstudents.org!](#)
- Please check out our website: [1millionenergyactions](#), for interactive and informational challenges, polls, and pledges!
- Follow us on our social media:
 - [Instagram](#)
 - [Facebook](#)

Introduce

What happens when you hold a ball on a hill and let it go? Earth's gravity makes the ball roll straight down the incline! Instead of having to throw it at the ground, gravity is able to move the ball without anything touching it. Forces that can act on objects without touching them are called **non-contact forces**. One such force is **magnetic force**. Magnetic forces are created by special objects called **magnets**. While gravity affects any object you can touch, magnetic forces can only affect certain types of objects, called magnetic materials. Magnetic materials will be drawn to a magnet in the same way a ball is drawn to the bottom of a hill!



What if we wanted to make a magnet out of materials you find around the house? One way to do that is

to pass electricity through a wire, creating an **electromagnet**. Electricity flowing through our wire is made up of electrons that flow like water in a stream. These flowing electrons can point magnetic objects downstream, just like a ball being dropped into moving water. Because of this similarity, both flowing water and flowing electrons are called **current**.

Investigate

In this lesson, you will be able to test and create electromagnets. If you have a magnet available in your home lets first explore what objects and materials it can pick up. What were some objects you were able to pick up with your magnet? What might be different when you use your electromagnet?

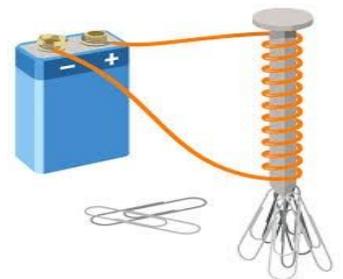
Our electromagnet will have a “core” of magnetic material (such as iron - nail) surrounded by a coil of wire through which an electric current is passed to magnetize the core (Merriam-Webster, n.d.). How might we make our electromagnet today? First, let’s draft up a plan!

Objective	Driving Question	Criteria	Hypothesis
Design an electromagnet that is strong enough to pick up small items.	How can I turn wire into a magnet	Must be able to attract and pick up metal objects	We/I predict...

1. Gather and prepare materials found in the materials section with the help of an adult. The recommended battery is D but use what you have available!
2. Take your nail and wire, wrapping the wire around the nail (20 loops minimum) and leaving about 3 inches free at the start and end of the wire (refer to electromagnet image).
3. Next, take one end of the wire and touch the positive (+) side and the other wire end to the negative (-) side! **Be careful here and don't leave your electromagnet attached too long because the battery will get hot and might spark (there's electricity flowing through there)!**
4. Leave the wire ends connected to their respective sides and then pick up the nail head. See how many objects you can pick up!

Make a hypothesis, or guess, for each of the following questions. Then, use your electromagnet to make observations and find the answer!

- How can we test the strength of the magnetic force?
- How will the number of wire loops affect your electromagnet?
- How will different batteries affect your electromagnet?



Wrap-up

Challenge questions:

1. Where else are electromagnets used in society?
2. Knowing that electricity moving through a coil of wire can make a magnet, what do you think will happen when you move a magnet inside of a coil of wire?

For more energy-based lessons and facts follow us on Instagram and Facebook @1MillionEnergyActions!

Glossary

Word	Part of Speech	Definition
current	noun	A stream of electric charge.
electromagnet	noun	A type of magnet with a magnetic field that is created by the flow of an electric current.
magnetic force	noun	The non-contact force exerted by a magnet on a magnetic object
magnets	noun	A piece of iron (or an ore, alloy, or other material) that has its component atoms ordered so that the material exhibits properties of magnetism, such as attracting other iron-containing objects or aligning itself in an external magnetic field.
non-contact force	noun	A force applied to an object by another body that is not in direct contact with it, e.g. weight.