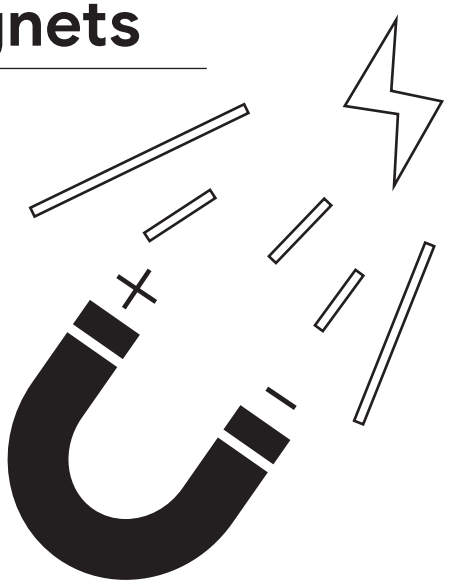
LESSON 2 | The Invisible Force of Magnets



Objective

Students will conduct an investigation and evaluate the experimental design to show that fields exist between objects exerting forces on each other, even though the objects are not in contact.

Time

45–60 minutes

Materials

- Bar magnets
- Testing materials such as: paper clips, pennies, nuts and bolts, staples, erasers, plastic pen caps, ball bearings
- Make Magnet Magic activity sheet

Extension Material

- This lesson is part of the "Science in Action" program. You can implement the lessons as standalone experiments or use them sequentially. Elevate experiments by using Google's free Science Journal app on classroom tablets or Chromebooks to measure and record observations; experiment data will be stored on Google Drive so you can access it across devices. To get more info and to download the app, go to **sciencejournal.withgoogle.com**.

Instructions

1 Place several objects on a table, such as a paper clip, an eraser, a copper penny, a staple, and a plastic pen cap. Hold up a bar magnet and ask students to predict how it will interact with each of the materials.

2 Break the class into small groups and give each group a bar magnet and a set of the same testing materials. Have students experiment with the materials and make a list of which are attracted to the magnet and which are non-magnetic (i.e., not affected by the magnetic field).

3 Give each group a second bar magnet. Explain that magnets have two poles, or points where the force of the magnetic field is the strongest. Every magnet has a north and a south pole. Have students experiment with placing the magnets near each other. Walk around the class as they work, and ask each group to explain what they think their results suggest about the orientation of the magnetic poles. (Answer: Similar poles will repel each other while the opposite poles will be attracted.)

4 Discuss some of the ways that magnets are used in daily life. Explain that magnets are used in high-speed maglev trains, and prompt students to use their observations to explain how magnets could be used to levitate a train and make it move forward. Prompt them to consider why the poles of a magnet are important, as well as their strength.

5 Hand out activity sheets. Give each group several bar magnets and a box of paper clips. Explain that they will now design their own experiment to test magnet strength. Circulate as they work and discuss their experiment plans. To measure the strength of magnets, students may choose to determine how many paper clips can be hung from a single magnet versus stacked magnets, or how close a single magnet/magnet stack needs to be before the paper clip is attracted to it.

6 At the end of the activity, compare each group's results and experiment designs as a class.

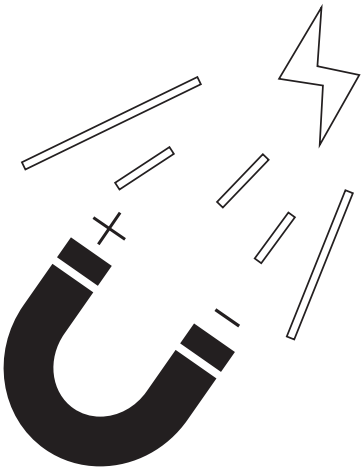
Science Journal Extension

While student groups are experimenting with magnets, allow them to take turns using the Magnetometer tool in the Science Journal app to measure how the strength of the magnetic field changes with distance from a magnet. When students have completed their experiments, allow them to use the app to measure the strength of a single magnet compared with stacked ones. Discuss how these results compare with the measurements they took on their activity sheets.

Name _____

Make Magnet Magic

Design a valid experiment with magnets and paper clips.



Step 1 Form a hypothesis, or prediction, about the following research question and write it in the space below: **How does stacking bar magnets affect the strength of the magnetic field?**

Step 2 Brainstorm an experiment design that could be used to compare how the strength of the magnetic field changes if magnets are stacked on top of one another.

Step 3 Record your results in the table below.

MAGNET SETUP	DATA COLLECTED		
	Trial 1	Trial 2	Trial 3

Step 4 Use data from your experiment to provide a conclusion.