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LESSON PLAN

MAGNETS AND STATIC ELECTRICITY
GRADES 3-5

SUMMARY

Students explore non-contact forces through magnets and static electricity. Prior to this lesson, students should have a basic understanding of contact forces.

DURATION

Two+ 45-minute class periods (Engage/Explore: 1 class period; Explain/Elaborate: 1 class period; Evaluate: homework)

PRE-ASSESSMENT QUESTIONS

Please see discussion questions located under the video. These can be discussed as a group or answered individually in student science notebooks.

ENGAGE

Show students, or allow them to explore (one magnet/paper clip per student/pair), that a paper clip is increasingly attracted to a magnet as the magnet is moved closer. Discuss/record in science notebook any student questions that the phenomena inspires which may be investigated.

MATERIALS

- Science notebooks (1 per student)
- Pencils
- Variety of magnets (1 per student or pair, can be reused in stations)
- Paper clips

Station 1
- A variety of magnets
- Metal and non-metal objects (paper clips, pennies, jewelry, nails, screws, pop tabs, bottle caps, plastic cups, spoons, paper, cloth, etc.)

Station 2
- 2 or more of the same magnets with N/+ and S/– poles labeled

Station 3
- Magnets of various strengths (possibly one neodymium magnet)
- Paper clips

Station 4
- Magnets of various strengths and multiples of one or more of the same
- Paper clips
- Rulers
- Station cards

DIY Activity Materials
- Cotton towel
- Plastic produce bag
- Scissors
- Balloon*

EXPLORE

Allow students to investigate how magnetic forces push and pull from a distance by exploring the following stations. Students should record observations, sketches, and questions in their science notebooks. (Instructor should circulate and provide guidance.) Science notebook entries serve as formative assessment. After visiting all stations, students should reflect on the focus questions from their exploration - through discussion or in their science notebooks - prior to moving forward.

STATION 1: MAGNETIC MATERIALS

Magnetic force acts at a distance, but only on some materials. At this station, students explore which types of materials are attracted to magnets and which are not by testing out attraction between magnets and various types of metal, plastic, paper, and so forth.

STATION 2: ATTRACTION AND REPULSION

Forces that act at a distance can both pull magnets together or push them apart depending upon how the magnets are oriented. At this station, students explore how magnets with labeled poles interact with each other.

STATION 3: STRENGTH OF MAGNETIC FORCE

How strong the force a magnet applies can be a factor of the type of magnet or how many magnets are working together. Students experiment with different types (strengths) of magnets and combining magnets.

STATION 4: DISTANCE AND MAGNETIC FORCE

At this station, students conduct a short investigation to provide evidence that magnetic force strength increases the closer a magnet is to the object on which the force is applied.

STATION 1 **WHICH TYPES OF MATERIALS DO MAGNETS ATTRACT?** Test the various materials to see whether magnetic force attracts them. Make a table in your science notebook that shows which materials are attracted by magnetic force and which are not.	**STATION 2** **HOW DO MAGNETS INTERACT WITH EACH OTHER?** Test the non-contact magnetic force between the labeled magnets in different configurations (+ to +, + to -, and so forth). What happens? Sketch the different scenarios you try in your science notebook.
STATION 3 **WHAT EFFECTS STRENGTH OF MAGNETIC FORCES?** Are all magnets the same strength? Test the different magnets and see how many paper clips they can pick up. Make a table in your science notebook showing your results.	**STATION 4** **DOES DISTANCE AFFECT STRENGTH OF MAGNETIC FORCE?** How close to an object does a magnet need to be before force is applied? Is it the same for all magnets? Place a paper clip at one end of a ruler and a magnet at the other. Move the magnet slowly toward the paper clip. Record the distance when you observe the magnetic force acting on the paper clip. Try with different magnets and record your results.

EXPLAIN

WATCH THE GENERATION GENIUS MAGNETS AND STATIC ELECTRICITY EPISODE AS A GROUP.

Then use the Discussion Questions to facilitate a conversation about what students observed in the video. These can be discussed as a group, in smaller groups, or individually by students in their science notebooks, providing formative feedback for the instructor.

ELABORATE

In the video, students saw examples of another type of non-contact force besides magnets—static electricity. Now students will investigate static electric force further. Have pairs or small groups of students complete the DIY Activity. Individually, students should sketch and label what was observed and how they understand what is happening, clearly indicating same or opposite charges.

EVALUATE

In their science notebooks, have students address the questions/scenarios related to non-contact magnetic and static electric forces. Pre-assessment questions can be asked again. Other examples:

- Sketch two scenarios, each with two magnets. In the first, magnetic force is pushing the magnets apart. In the second, magnetic force is pulling the magnets together. Label the poles on the magnets accordingly. Students should explain any forces that are applied and how they work if the magnets are not touching.
- Show the students three magnets (one separate and two together), aluminum foil or a pop tab, and nails. What will happen if the magnets are moved close to the foil and nails? Are the forces involved the same for the single magnet and the two together? How do the forces change if the magnets are moved closer to the foil/nails?
- Compare/contrast magnetic force and static electric force. How is the interaction between two like magnetic poles (N/+ and N/+) similar or different from the interaction between the balloon and bag from the video?

EXTENSIONS

- Further exploration of electromagnets.
- Research/design devices that utilize magnets or static electricity to solve a problem.
- Classroom experimentation with encased metal filings and/or encased ferrofluid.