Third Grade Physical Science

MAGNETIC CARS: Forces and Motion

Background Information

Any moving electrical charge surrounds itself with a magnetic field. The electrons moving around within atoms are no exception. In most materials, the electrons are spinning and moving in random directions and their individual fields cancel out, leaving the material with no overall magnetic field. In some materials, however, the electrons can be organized so they all spin and move alike. Now their individual magnetic fields add together to produce an object with an obvious overall magnetic field.

Such an object, called a magnet, has a field with two poles, north and south. Like polls repel each other and opposite polls attract. These forces diminish in strength as the distance between the magnets increases.

Magnetic fields can affect the electron motion within certain metals, like iron and steel, causing them to become temporarily magnetic. Such materials are only attracted to magnets, not repelled. Other metals, such as aluminum, are not affected in this way. These properties can be used to make many useful devices.

Performance Expectations

3-PS2-3 Motion and Stability: Forces and Interactions

Ask questions to determine the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

https://www.nextgenscience.org/pe/3-ps2-3-motion-and-stability-forces-and-interactions

3-PS2-4 Motion and Stability: Forces and Interactions

Define a simple problem that can be solved by applying scientific ideas about magnets.

https://www.nextgenscience.org/pe/3-ps2-4-motion-and-stability-forces-and-interactions

Disciplinary Core Ideas

PS2.B: Types of Interactions - Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Science and Engineering Practices

Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

Ask questions that can be investigated based on patterns such as cause and effect relationships.

Crosscutting Concepts

Cause and effect relationships are routinely identified, tested, and used to explain change.

Objectives

- Students will learn that magnets can apply both pushing and pulling forces on other magnets depending on orientation.
- Students will explore the idea that magnets can apply pulling forces on some metals but not others.
- Students will investigate magnetic forces diminish with distance.
- Students will learn that magnetic forces can be used as a tool to regulate the motions of certain objects.

Materials

For the class

- 1 or more hand-held circular hole punches
- Coloring supplies if students are to decorate cars

For each group (of 2 or 3 students)

- 1 car template printed on card stock
- 4 wheels
- 2 aluminum axles
- 1 roll of tape
- 1 large paperclip
- 5 small magnets

Suggested Approach

Part I

Begin with some questions to stimulate memories of prior experiences.

- *How many objects can you name that make use of magnets?*
- *How are the magnets used in each of those objects?*
- *Can magnets effect something without touching it? Give an example.*
- *Can magnets change the way something moves? Give an example.*

Help students form groups of two or three. Pass out student pages. Explain the procedure for assembling the cars, then pass out materials.

1. Cut along the dotted lines.
2. Fold along the solid lines to make an open rectangular box.
3. If students will be decorating their cars, now would be the best time to do that.
4. Tape the corners to keep the box rigid.
5. Use a hand-held hole puncher to make a circular hole at the four locations marked with a circle.
6. Axles go through the circular holes.
7. Carefully push wheels onto the axles.
8. Test the car to see if it rolls freely and adjust wheels and axles as necessary.

9. Tape a paperclip to the center of one bumper.
10. Tape one magnet to the center of the opposite bumper.

Part 2

Challenge students to use magnets to make their car move, without allowing anything to touch the car. Have them do this as many different ways as they can. As they play, students are to record observations and questions about the behavior of their magnet car.

Have students put their cars out-of-reach, perhaps on your desk, for the following class discussion. Students share their observations and questions. On the board, or on chart paper, record:

- *Any question which might possibly be answered by allowing students to do an experiment*
- *Any observation which could be tested in a controlled way to see if it can be repeated*

Once you have about five statements recorded, allow the class to select one statement for which they will design an experiment that could answer the question or confirm the observation.

After conducting their experiments, have students share results and discuss any discrepancies between their results.

If time and student interest allow, conduct further experiments.

Part 3

Ask students to think of the various problems that cars might encounter on a road. Could magnetic forces be able to prevent or solve any of those problems?

Have each group select one potential problem or danger faced by driving on the road in a car. Students may use their magnets to modify the car or the road in some way to solve the problem. Allow them to be creative.

Have students put their cars out-of-reach, perhaps on your desk, for the following class discussion.

Debrief:

Allow each group to present their work.

- *What problem did you want to solve? Explain your solution.*
- *Did it work?*

Resources

Book suggestions from: http://www.kbs.msu.edu/wp-content/uploads/2017/02/NGSS-Interactive-Read-Alouds.pdf

- Branley, F. (2016). *What makes a magnet?*
  Why does a magnet pick up a paper clip but not a leaf or a penny? How can the whole world be a magnet? Follow the step-by-step instructions about how to make your own magnet, and then find out for yourself what makes a magnet!

- Stewart, J. (2000). *Magnets.*
  Very simple photographic book invites the reader to predict and test theories of magnetic forces on common objects.

- Alpert, B. (2011). *A look at magnets.*
  Magnets stick to your refrigerator. Magnets make paperclips jump. Read more to find out the facts on magnets.

- Weakland, M. (2011). *Magnets push, magnets pull*.
  Can a magnet really crush a car? How do magnets stick to the fridge without tape or glue? Discover the wonder and science of magnets.

- Hughes, M. (2015). *Magnet Max.*
  Magnet Max loves experimenting with magnets. He knows all about how they work and loves using them to attract new types of things. But when he shows them to his friend Nick, the other boy is baffled. Join Max and Nick as they explore the science behind the magic.

- Rosinsky, N. (2002). *Magnets: Pulling together, pushing apart.*
  Compasses and magnetite, magnetic poles and motors - learn about how magnets affect our lives.

- Watley, B (1993). *That magnetic dog*.
  Skitty is a very special dog - she's magnetic. But instead of attracting metal, she attracts food. All kinds of food, even peas!

- Schanzer, R. (2002). *How Ben Franklin stole the lightning*.
  Ben Franklin found a way to steal the lightning right out of the sky. Is such a thing possible? Is it. This book describes how he used his discovery about lightning to make people's lives safer.

Assessment

The following single point rubric can be used to assess student understanding. For each of the criteria listed below, either circle the proficient description or add notes to a box indicating why the student's performance was either lacking or exceptional.

Areas that need improvement. **Developing Performance**	Criteria for **Proficient Performance**	Evidence of exceeding standards. **Advanced Performance**
	Can provide examples of pushing and pulling forces from magnets.	
	Can explain in simple term that some substances do not react to magnets.	
	Can provide an example of how magnetic forces can be used to regulate motion of some objects.	