Unit 2: Forces at a Distance
8th Grade Science

12 Class Meetings

Revised January 2026

Essential Questions

- How do invisible forces between magnets and coils transfer energy and cause motion, and how can we use data to explain and predict these effects?

Enduring Understandings with Unit Goals

EU 1: Electrical and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.

- Formulate questions that arise from examining given data of objects interacting through electric and magnetic forces.
- Predict the strength of electrical and magnetic forces due to cause-and-effect relationships.
- Distinguish between possible outcomes, based on an understanding of the cause-and-effect relationships driving the system.

EU 2: Forces that act at a distance (electrical, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively).

- Evaluate evidence that two interacting objects can exert forces on each other even though the two interacting objects are not in contact with each other.
- Analyze data that distinguishes between electric and magnetic forces.
- Show evidence that the cause of a force on one object is the interaction with the second object.

EU 3: A system of objects may also contain stored (potential) energy, depending on their relative positions.

- Develop a model to make sense of two objects interacting at a distance identifying forces, distance between the objects, and potential energy.

EU 4: When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

- Identify and describe the relationships between components including forces, energy transfer, and the potential energy of a system.
- Use a model to describe the amount of potential energy in a system of objects changes when the distance between stationary objects interacting in the system changes.

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Standards

Next Generation Science Standards:

- **MS-PS2-3:** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- **MS-PS2-5:** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- **MS-PS3-2:** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

Common Core State Standards:

- **CCSS.MATH.7.PR.1:** Compute unit rates associated with ratios of fractions including ratios of lengths, areas, and other quantities measured in like or different units.
- **CCSS.MATH.6.NS.C.8:** Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
- **CCSS.ELA-LITERACY.RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts.
- **CCSS.ELA-LITERACY.RST.6-8.1:** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- **CCSS.ELA-LITERACY.RST.6-8.9:** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

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ISAAC Vision of the Graduate Competencies

Competency 1: Write effectively for a variety of purposes.
Competency 2: Speak to diverse audiences in an accountable manner.
Competency 3: Develop the behaviors needed to interact and contribute with others on a team.
Competency 4: Analyze and solve problems independently and collaboratively.
Competency 5: Be responsible, creative, and empathetic members of the community.

Unit Content Overview

1. **Forces Observed in Electromagnetic Interactions**

    - Observe and explain the push and pull forces that occur when a magnet and a coil of wire interact across a distance.

1. **Interacting Forces**
    - Determine how energy transfers through electromagnets.
    - Determine how energy transfers across space between magnets.

2. **Magnetic and Electric Fields**
    - Design and carry out a set of investigations that provide evidence for what factors affect the strength of magnetic fields.

Interdisciplinary Connection:

- Language Arts- Students apply cause-effect sentence frames as they routinely identify, test, and use relationships to explain change throughout the unit.
- Math- Students will collect, manipulate, and analyze data from several investigations. Students will calculate the rate of change from data collected and organized in a table. Students will graph data in two quadrants of the coordinate plane and interpret the meaning of data in graphs.

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Daily Learning Objectives with *Do Now Activities*

Students will be able to…

- Ask questions and develop an initial model to describe how interactions between parts of a speaker system cause sound without those parts touching each other.
    - Observe a slow-motion video of a speaker playing music. Brainstorm how to investigate the force inside the speaker that causes it to vibrate.
- Collect data to establish that magnets interact with certain objects to cause paired forces that are either attractive or repulsive. Develop a logical argument based on evidence that connecting a coil of wire to a battery causes the same paired forces as between two magnets.
    - We suspected that the magnet was pushing and pulling on something. Why? What do we already know about what magnets can push and pull on? What do you predict will happen when we put the magnet up close to the metal wire without letting it touch?
- Develop and test a set of hypotheses to produce evidence that energy can transfer between magnets without transferring through matter. Construct an argument supported by evidence and scientific reasoning that energy can transfer between magnets.
    - Is the coil of wire a magnet when it is connected to the battery? Why or why not?
- Use diagrams and simulations to model the patterns we observe about the invisible space around a magnet.
    - Fill in the blank using words from the word wall to complete the sentences that describe what we have figured out so far.
- Use a computer interactive to model the effect on the patterns in the magnetic field when we add an electromagnet to the single magnet system.
    - How is the speaker system different from this picture (screenshot from computer simulation)? Draw the arrow on the circle to show what the compass would do next to a magnet?
- Demonstrate mastery of the unit goals so far. (Mid-Unit Quiz)
- Ask questions and carry out investigations to answer questions about how the pattern of energy flow compares in different systems using a speaker, a wire coil, a lightbulb, a battery, and a computer. Critically read scientific text to gather evidence to explain the differences in the electric current produced by the computer that results in a changing magnetic field within the speaker.
    - Fill in the blank using words from the word wall to complete the sentences that describe what we have figured out so far.
- Revise a model to describe how the magnet and the electromagnet work together to move the speaker.
    - Fill in the blanks of the cause-and-effect statements.
- Investigate how distance affects the strength of force pairs in a magnetic field. Construct and use a graphical display of data to identify patterns in the relationship between distance and magnetic forces.
    - Hold up two bar magnets with the like poles facing each other. Keep the poles about 6

inches apart. What could we do to increase the strength of the magnetic forces between two magnets?

- Investigate what factors cause changes in the strength of magnetic forces. Analyze and interpret data to identify linear and nonlinear relationships between various independent variables and their effect on the strength of magnetic forces. (Unit Task)
    - Fill in the cause-and-effect statements to figure out how the vintage doorbell works.
- Demonstrate mastery of the unit goals. (End of unit assessment)

Instructional Strategies/Differentiated Instruction

- Whole group instruction
- Guided notes
- Interactive Notebooks
- Student-led instruction
- Independent problem-solving
- Collaborative problem-solving
- Graphic Organizer
- Cross-curricular problem solving (independent and collaborative)
- Accountable Talk
- Homework
- Word walls with visuals
- Small group instruction
- Investigations/labs
- Choice Boards

EL Differentiated Instruction:

- Sentence starters
- Simplified directions
- Prompting and questioning
- Alternate responses when needed
- Explicit modeling
- Key vocabulary
- Visuals
- Graphic organizers
- KWL charts
- Venn diagram
- Glossary
- Frayer Model

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Assessments

FORMATIVE ASSESSMENTS:

- Do Now
- Notebook checks
- Mid-class check-ins
- Exit Slips
- Accountable Talk Discussions
- TWPS
- Homework
- NGSS Interim Assessment

SUMMATIVE ASSESSMENTS:

- Quiz – EU 1-2 & EU 3-4
- Unit Task- Electromagnetic Inventions- What cause-effect relationships explain how magnetic forces at a distance make things work?
- Unit Test

Unit Task

Unit Task Name: Electromagnetic Inventions

Description: Students will be given a list of electromagnetic devices/inventions. Students will draw a model that explains how the device works. The model should include forces acting at a distance. (EU1). Students will then describe the cause-and-effect relationships that allow the device to work and explain how they made the modeled device work.(EU2 & EU3). Lastly, students will be asked to design an investigation where a different metal (silver) is used instead of copper (EU4). Although students will not be performing the investigation they designed, they will be asked to use any combination of drawings and words to describe patterns they would expect to see in their data.

Evaluation: Teacher Created Unit Task Rubric/Scoring Guide

Unit Resources

- Science notebook
- Laptop
- NGSS Resources
- NGSS Item Tracker
- NGSS Interim Assessments Physical Science Items
- Pear Assessment
- Newsela.com
- Diffit.com
- PHET Simulators
- Turner's Graph