THIRD GRADE: ELECTRICITY AND MAGNETS

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

3-PS2-3 Ask questions about cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (SEP: 1; DCI: PS2.B; CCC: Cause/Effect) [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paper clips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] *[Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]*

3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets. (SEP: 1; DCI: PS2.B; CCC: Technology) [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

Electric and magnetic forces can change the motion of an object without having contact with that object. Electric and magnetic forces can either push or pull. The size of the push or pull on an object depends on the properties of the objects and the distance between the objects. The forces caused by two magnets depend on their orientations of north and south.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- After rubbing a balloon on your hair, it stands on end.
- Hair stands on end when touching an active Van De Graaff machine.
- Clothes clinging together.
- A machine (electromagnet) picks up large amounts of scrap metal or cars, moves them to another location, then releases them.
- The shock when a door knob is touched.

- Maglev transportation system.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems ● Ask questions that can be investigated based on patterns such as cause and effect relationships. ● Define a simple problem that can be solved through the development of a new or improved object or tool.	**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.	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change.

Students ask questions from observing two objects not in contact with each other interacting through electric and magnetic forces. Students can investigate these questions through observations of cause and effect relationships between the sizes of the forces on the two interacting objects due to the distance between the two. The cause and effect may be between the relative orientation of two magnets and whether the force between the magnets is attractive or repulsive. The cause and effect relationship may be the presence of a magnet and the force the magnet exerts on other objects. The cause and effect relationship may be electrically-charged objects and an electric force.

Students identify and describe a simple design problem that can be solved through an understanding of forces between interacting magnets. Students' scientific ideas may include forces between objects that are not in contact with each other. Students communicate that magnetic and electrostatic forces transfer energy through space. For example, the observation of static electricity by rubbing balloons on their head. The size of the force depends on the properties of the objects, the distance between the objects, and orientation of magnetic objects relative to one another. Two magnets will cause either an attraction to each other or cause each other to repel, depending on their orientation. Students can observe that the size of the forces are affected by the objects distances and the properties of the object as they test different objects with different properties to see if a magnetic or electric force changes the object's motion.

As students explore and demonstrate their understanding of electric and magnetic forces, they will also explore everyday problems that can be solved by the use of the electric or magnetic forces. Students apply the forces of magnets to solve a simple design problem. They define problems and ask questions that can be investigated and solved based on the patterns of electric and magnetic forces. Students identify and describe criteria for a successful solution and constraints such as time, cost, and materials in the development.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Asking Questions and Defining a Problem

- What problem does the electromagnet used in the junkyard solve? How/where else are electromagnets used to solve a problem?
- Find ways the static from a balloon affects different objects.
- List questions you have as you observe and manipulate magnets.
- List questions you have as you observe the contact between a balloon and different materials.

CCC Cause and Effect

- Explain how the size and/or distance between magnets affects its ability to attract.
- Why can a larger magnet pick up more than a smaller magnet?
- What causes the electrostatic forces between a charged balloon and your hair?
- Explain why magnets can both repel and attract.
- Explain the interaction between a magnet and electricity.

CCC Technology

- How have magnets have saved time, money, and materials in our society?

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are *potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.*

- **Ask testable questions** about the *causes or effects* of electric and magnetic forces that are present between an electrically charged object and a magnet.
- **Ask testable questions** about how the size of the force *is impacted by* the orientation, properties and distance between objects.
- **Describe a simple design problem** and how **it can be solved** by using the *effects* of magnetic forces.