Unit 3 Electrical and Magnetic Forces

Unit Summary: In this unit of study, students determine the effects of balanced and unbalanced forces on the motion of an object and the cause-and-effect relationships of electrical or magnetic interactions to define a simple design problem that can be solved with magnets.

Concepts and Vocabulary: Key vocabulary may include but are not limited to: Forces (e.g. number, size, direction, Balanced, Unbalanced), Motion (e.g. starting, stopping, or changing direction), Object, Cause and Effect, Patterns of motion (e.g. swinging pendulum, ball on curved track, magnet repulsion), Future motion

Stage 1 – Desired Results

Performance Expectations: (PE) (Established Goals / Content Standards)

3-PS2-3: **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** 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 the 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. Clarification Statement: Examples of problems could include constructing a latch to keep the door shut and creating a device to keep two moving objects from touching each other.

Enduring Understandings (1-3 max)	**Essential Questions** (1-2 EQ per EU)
Cause-and-effect relationships are routinely identified, tested, and used to explain change. Scientific discoveries about the natural world can often lead to new and improved solutions to problems. Ask questions that can be investigated based on patterns and observations.	What are the relationships between electrical and magnetic forces? How do the properties of magnets allow them to be useful to society? How can we use our understandings about magnets be used to solve problems? Why are magnets essential to our everyday lives?

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

Analyzing and Interpreting Data ● Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1) **Asking Questions and Defining Problems** ● Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3) ● Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4) ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)	**PS2.B: Types of Interactions** ● Electric and magnetic forces between a pair of objects do not require that objects be in contact. The sizes of the forces in each situation depends on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4) **ETS1.A: Defining and Delimiting Engineering Problems** ● Possible solutions to a problem are limited by the available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3) - **Connections to Engineering, Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** ● Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)

Stage 2 – Model Assessment	
Summative Performance Task(s) Students will experiment with static electricity. 1. Children write a prediction down in their science journal about what will happen when you place two static electrically charged balloons next to each other. 2. Rub the 2 balloons one by one against the woolen fabric, then try moving the balloons together. Do they want to attract or do they repel each other? 3. Children record a prediction about the effects of rubbing a balloon against their hair. 4. Rub 1 of the balloons back and forth on your hair then slowly pull it away. Have group members observe what	**Formative Evidence:** **Mystery Science Magnet Assessments** https://mysteryscience.com/docs/116 https://mysteryscience.com/docs/519 **Invent a Magnet Lock** In the activity, students apply their scientific ideas about magnets to create a useful product: a magnetic lock. Students engage in the engineering design process to test and improve their designs. https://mysteryscience.com/forces/mystery-5/magn

happens. 5. Predict what will happen when you place a static electrically charged balloon next to an aluminum can. 6. Put the aluminum can on its side on a table. After rubbing the balloon on your hair again, hold the balloon close to the can and observe what happens. Does it roll towards it or away? Slowly move the balloon away from the can and see what happens. Materials Needed: Two balloons per group, One tin can per group, One piece of woolen fabric per group. Probing or Clarifying Questions: In small groups or pairs, students discuss possible everyday problems that might be solved using magnets. For example, they could construct a latch to keep the door shut. As a class, determine possible criteria that might be used to determine how successful the devices might be, and discuss possible constraints that might affect each group's design solution. Small groups or pairs should have the opportunity to create a presentation (poster, PowerPoint, drawings, or actual physical model) to share both the design problem and solution with the class. **Self Assessment Rubric** https://www.exemplars.com/assets/files/seed.pdf	ets-engineering/151?r=47229275 **Short Performance Assessment:** https://docs.google.com/document/d/1fMRog_m_JJeWilaHtNniWo0riYF9L0deIYmmCvtTa8Q/edit **Possible Assessment:** https://betterlesson.com/lesson/636978/magnet-assessment

Stage 3 – Learning Plan and Resources
Suggested Resources for Planning: Mystery Science - www.mysteryscience.com Newsela - www.newsela.com
Learning Activities: **What Are Magnets?** In this lesson, students will make predictions and observations to determine the cause and effect relationship between magnets and magnetic and nonmagnetic items. http://betterlesson.com/lesson/636548/2-what-are-magnets **Magnetism Exploration** Students will be able to identify objects that are attracted or repelled by magnetism. http://betterlesson.com/lesson/638686/magnetism-exploration **Using Magnets to Solve Real World Problems**

In this lesson, students will be able to use their knowledge of magnetism to solve a problem or respond to a situation.
https://betterlesson.com/lesson/639709/i-need-a-magnet

Magnet Lessons
This packet includes a variety of lessons on magnets. Lessons include experiments, stations, and discussions about electrical and magnetic forces.
http://www.mccracken.kyschools.us/Downloads/FORCES%20INTERACTIONS%203.pdf

Brain-Pop video with attached quizzes:
https://jr.brainpop.com/science/forces/magnets/

Free Internet Resource (includes printables):
https://www.greatschools.org/gk/worksheets/page/6/?grade=3rd-grade&category=science
https://thewonderofscience.com/3-forces-and-interactions

2 Possible In-Class Experiments:
https://learning-center.homesciencetools.com/article/all-about-magnets-science/

Suggested Methods: (The following methods anchor learning with a purpose, mitigating the “why do I need to know this” questions.)

- Phenomena based learning
- Problem Based Learning (PBL)
- Inquiry Based Learning
- Case studies
- Engaging in Argument w/ evidence