**6th Grade Launch Unit**

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| **Unit Topic: Electricity and Magnetism****Estimated Time: 2 Weeks****This Launch Unit is designed to address a possible gap between 5th Grade Science and 6th Grade Science.** |
| **Standards** |
| S5P2. Obtain, evaluate, and communicate information to investigate electricity. a. Obtain & combine information from multiple sources to explain the difference between naturally occurring electricity (static) & human harnessed electricity. b. Design a complete, simple electric circuit, & explain all necessary components. c. Plan and carry out investigations on common materials to determine if they are insulators or conductors of electricity. S5P3. Obtain, evaluate and communicate information about magnetism & its relationship to electricity. a. Construct an argument based on experimental evidence to communicate the differences in function & purpose of an electromagnet & magnet. b. Plan & carry out an investigation to observe the interaction between a magnetic field and a magnetic object.[Click here to see the Electricity and Magnetism Learning Progression – Appendix A](#appendixA) |
| **Science and Engineering Practices & Crosscutting Concepts:** [See Appendix B](#AppendixB) |
| **Teacher Background Knowledge** |
| * Electric forces and magnetic forces are different aspects of a single electromagnetic interaction.
* Such forces can be attractive or repulsive, depending on the relative sign of the electric charges involved, the direction of current flow, and the orientation of magnets.
* The forces’ magnitudes depend on the magnitudes of the charges, currents, and magnetic strengths as well as on the distances between the interacting objects.
* All objects with electrical charge or magnetization are sources of electric or magnetic fields and can be affected by the electric or magnetic fields of other such objects.
* Attraction and repulsion of electric charges at the atomic scale explain the structure, properties, and transformations of matter and the contact forces between material objects.
* Coulomb’s law provides the mathematical model to describe and predict the effects of electrostatic forces (relating to stationary electric charges or fields) between distant objects.
* Forces that act at a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object (a ball, a charged object, or a magnet, respectively).
* Magnets can exert forces on other magnets or on magnetizable materials, causing energy transfer between them (e.g., leading to changes in motion) even when the objects are not touching.
* Electric and magnetic fields also contain energy; any change in the relative positions of charged objects (or in the positions or orientations of magnets) changes the fields between them and thus the amount of energy stored in those fields.
* When a particle in a molecule of solid matter vibrates, energy is continually being transformed back and forth between the energy of motion and the energy stored in the electric and magnetic fields within the matter.
* Energy can be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents).

Source: National Research Council. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165. |
| **Big Ideas/Enduring Understandings:** * Non-contact forces include magnetic, electric, and gravitational.
* Non-contact forces can act a distance; but will strengthen or weaken based on the properties of the interacting matter.
* Matter can have a positive, negative, or neutral charge. Matter is typically neutral. However, the movement of electrons within the atoms of matter can temporarily change the charge.
* When matter interacts with non-contact forces, like charges repel while unlike charges attract.
* Magnetic and electric forces are similar in that both their presence and strength are based on the movement of electrons around the nucleus of an atom.
* Matter consisting of iron or nickel can be easily magnetized. This can occur because the electrons in these atoms tend to move in the same direction.
* The electrons in some matter will more easily move around. These are known as conductors. Matter with electrons less willing to move around are known as insulators.
* Non-contact forces occur naturally; but can also be human engineered.
* Humans combine forces to engineer solutions to various problems (e.g. temporary magnet, manufacture electricity to support energy transformations).
 | **Essential Questions:*** How does that work exactly?

 …..lightning? …..electricity in our houses?* How did we get from lightning to power plants/electricity in our houses?
* How do birds know where to migrate?
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| **Vocabulary: (Synonymous to Concepts)**Noncontact Forces Attraction/Repulsion Electricity (static, current) Electric Force Circuit (open, closed, series, parallel) ElectromagnetismMagnetic Force Conductor/Insulator Atom (proton, neutron, electron)Gravitational Force (transition concept) |
| **Literature Connections:***The Boy Who Invented TV: The Story of Philo Farnsworth* by Kathleen Krull*Young Thomas Edison* by Sterling North*Electrical Wizard: How Nikola Tesla Lit Up the World* by Elizabeth Rusch*The Shocking World of Electricity with Max Axiom* by Liam O’Donnell*That Magnetic Dog* by Bruce Whatley*How Ben Franklin Stole the Lightning* by Rosalyn Schanzer |  **STEM Career Connections:** |
| **Materials and Safety Considerations:**\*\*Lessons are designed with simplicity in mind. Full materials lists and safety considerations can be found if you look below for “Click here for full lesson.” |  **Distance Learning Options:** \*\*Pieces of the lessons that can easily be adapted or used as-is for distance learning are highlighted below |
| **Lesson Components** |
| **PHENOMENA****(*Storyline Approach to Transitioning into MS Earth Science Unit 1: Astronomy)*** |
| ***TOPIC 1: Obtain, evaluate, and communicate information to investigate electricity.*** | ***TOPIC 2: Obtain, evaluate and communicate information about magnetism & its relationship to electricity.*** | ***TOPIC 3:*** ***Plan & carry out an investigation to observe the interaction between a magnetic field and a magnetic object.*** |
| **ENGAGE** |
| *Topics 1 & 2 merged in order to efficiently investigate the content, as well as, allow the storyline to be cohesive.*

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| ***TOPIC 1: Obtain, evaluate, and communicate information to investigate electricity.*** | ***TOPIC 2: Obtain, evaluate and communicate information about magnetism & its relationship to electricity.*** |

* Show students the above images (lightning bolts, power lines) side by side and provide several minutes of thinking in the “alone zone.”
* Ask students to draw the images at the top of their papers and jot down a few descriptors for each. For example:

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| **white-blue** |  |
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* Show additional images of phenomena. Provide time for students to categorize them as either more like the lightning or more like the power line. (Possible images inserted below) Encourage students to simply write/label each photo to include in their list. For example, “boy sliding.”
* Provide time for students to engage in partner conversation to discuss their decisions and reasons.

Model partner conversation aloud and make a conversation starter sentence visible (on the board/screen). For example, “I chose to put the \_\_\_\_\_\_\_\_\_\_\_\_\_ under the \_\_lightning/power lines\_\_ because \_\_\_\_\_\_\_\_.” Then model for students how to show their partner that they listened to their contribution and either agree/disagree. For example, “I also thought the \_\_\_\_\_\_\_ should go under the \_\_\_\_\_\_\_\_\_\_\_\_ but I thought it should go for a different reason. I thought it should go there because \_\_\_\_\_\_\_\_.”Facilitate large group coversation using the following prompts:* Allow volunteers to share their decisions/reasons for the phenomena shown.
* *Was there anything I showed you that may have fit under both categories?* Allow students to engage in partner conversations to make a decision, and then allow a volunteer to provide any overlapping phenomena.
* *How did you decide to distinguish one category over the other?*
* *Are there any words you know that may allow us to give these groups specific names?* Allow students to engage in partner conversations to consider this, and then allow a volunteer to provide any ideas.
* *There are two words people will use that might help us. The word* ***sta****tic, which means to* ***stay*** *still. Then there is also the word, current, which means flowing in a definite direction, like an ocean current.* Allow students to engage in partner conversations to consider this, and then allow a volunteer to provide their ideas.
* If students have not already indicated that one category occurs naturally and the other is human engineered, than also ask the question *If we need to distinguish between one naturally occurring and one engineered by humans, which group would be labeled accordingly?*
* Transition into the explore phase by providing time for students to record any questions they might have about any of the phenomena you have presented to them. Consider the use of a Jamboard, Nearpod, etc. for students to post their questions.
* After reading students’ questions summarize them all by saying, so one thing we are all kind of wanting to know is, “How do these things work? How do they do they happen?”
 | ***TOPIC 3:*** ***Plan & carry out an investigation to observe the interaction between a magnetic field and a magnetic object.***Show students the model of Earth’s magnetic field. Provide time for individual consideration of the model. Encourage students to critique the model: consider what the model does a good job of showing, and then to consider what the model does not do a good job of explaining.Provide time for partner conversation to critique the model. Set the expectation that each partner must show that they were listening ***and*** contribute something new. Consider modeling the rules for conversation. For example,Student A: *I noticed that the model does a good job of pointing out that there are 2 north poles.*Student B: *Yea! I noticed that too, but I also thought it didn’t do a good job of telling me why there were 2 north poles. I thought there was just one.*Facilitate large group conversation. Allow volunteers to first share parts of their critique. Then prompt students to generate questions that can be investigated. For example:*Based on the things you noticed were not explained well in the model, are you wondering about anything?*Record student wonderings in a place visible for all *or* consider the use of a Jamboard, Nearpod, etc. for students to post their questions.The following questions can be anticipated:*Why are there 2 north and south poles?**Why is it brighter at the poles?**Why do the lines go out so far?**Why is the Earth magnetic anyway?**Is magnetism what keeps everything on Earth?**Is magnetism why the earth spins?*Make explicit the learning objective: *better understand magnetic forces and properties because this will help us understand earth’s place in space*, as well as, a bunch of other “stuff” we will learn about this year. Transition to the explore phase by assessing student current understanding of magnets. Consider using [S5P2.3-Electricity and Magnetism-Lesson 1-PROBE](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=22E7BE6A-FB98-436C-8D33-021B61606B6F). |
| **EXPLORE** |
| * Links in the explain phase include both the explore/explain for these two topics.
 | Students explore magnetic force and properties, as well as, begin to formalize explanations via:* [S5P2.3-Electricity and Magnetism-Lesson 1-Amazing Magnet Stations](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=e41440bc-37ba-491d-85fb-26de84b5f07b&t=v)
* [S5P2.3-Electricity and Magnetism-Lesson 1-Amazing Magnets Lab Sheet](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=32c23653-aa43-492b-969d-146ae43338b3&t=v)
 |
| **EXPLAIN** |
| ***TOPIC 1: Obtain, evaluate, and communicate information to investigate electricity.*** | ***TOPIC 2: Obtain, evaluate and communicate information about magnetism & its relationship to electricity.*** | ***TOPIC 3:*** ***Plan & carry out an investigation to observe the interaction between a magnetic field and a magnetic object.*** |
| [It's Shocking](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=a6c21e20-f50d-423b-be72-44ec51dbe44e)Students discover why things cling and the differences between human-harnessed and static electricity. They will do several hands-on activities to better understand attraction, repulsion, static electricity, and human-harnessed electricity.* [S5P2.3-Electricity and Magnetism-Lesson 3-Static Electricity Stations Recording Sheet](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=62e51b1c-357e-48a5-b83b-648d5e071f86&t=v)

*Teacher Hint: In these provided lesson plans, you will modify the provided phenomenon to incorporate those phenomena you have previously engaged students in thinking about.*  | [It’s Electric](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=e2d6a6ed-1bd1-4116-b57f-45efdc61332a)Students learn about electricity, electric currents, and electric circuits. They create simple circuits and fill out graphic organizers to explore electric currents, circuits, and switches.--transitions into magnetism via…[Magic Magnets](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=3e02493b-d6b7-4038-bc59-b550d9d80987)Students learn about how electricity and magnetism are connected. They will create several different electromagnets to see if they can determine what makes the strongest electromagnet and conduct experiments with permanent and manmade magnets.[S5P2.3-Electricity and Magnetism-Lesson 2-Magic Magnets Lab](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=c92bf3af-6d06-4620-abfb-cae57de1ea4e&t=v) | In the alone zone, students revisit the *Magnetic Personality* probe and change any of their answers, using a new color pen or marker. Then in partner conversations students compare/discuss answers. Large group conversation then facilitated to address any inconsistencies between partnerships and/or clarify understandings as needed.Students then re-visit the initial model of Earth’s magnetic field, adding to/taking away new information based on knowledge acquired in the explore phase.Students then acquire more information as needed using the following resources:HMH Textbook pages 250-253<https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields/magnets-magnetic/v/introduction-to-magnetism><https://www.nasa.gov/vision/earth/lookingatearth/29dec_magneticfield.html>Students revise their models based on obtained information. |
| **EXPAND** |
| ***TOPIC 1: Obtain, evaluate, and communicate information to investigate electricity.***Read Aloud/Video Aloud *Now and Ben*: *The Modern Inventions of Benjamin Franklin* by Gene Barretta <https://youtu.be/EK_4XA8OZZA> | ***TOPIC 2: Obtain, evaluate and communicate information about magnetism & its relationship to electricity.***Read Aloud/Video Aloud *When Charlie McButton Lost Power* by Suzanne CollinsBook in PDF with Explicit Reading Strategies:<https://www.pearsonsuccessnet.com/temp-images/scorm/rdg10/na/en/0-328-73641-4/A21554/pdf/RSEN11_G3U1W1_ms.pdf>Video:<https://youtu.be/S-Jx2Rl5EqI>  | * ***TOPIC 3:*** ***Plan & carry out an investigation to observe the interaction between a magnetic field and a magnetic object.***

Provide time for students to analyze the map of bird migration patterns. Ask students if they know of other birds that migrate. Read aloud the beginning portion of the article *How Do Birds Navigate?* from <https://ssec.si.edu/stemvisions-blog/how-do-birds-navigate>: *If you were lost in the middle of the woods and could not see the Sun, you might use a compass to try to decide which direction to take. A magnetic compass needle lines itself up with Earth’s magnetic field and points roughly north and south: from that, you can figure out east and west, too. Because this works fairly well, people have been using magnetic compasses to find their way for about 1,000 years.**But how do other animals find their way? How do they navigate when it is cloudy?*Ask students to consider all that they have learned thus far to write a prediction about how birds and other animals navigate/migrate. Provide time for students to jot their thoughts, and then allow any volunteers to share their initial thinking.Allow time for students to individually finish reading the article, and then add to/take away from their jots based on the textual evidence.Summarize with student volunteers sharing the possible explanations and making explicit the nature of science as an ongoing endeavor set to make sense of how the world works. |
| **ADDITIONAL RESOURCES** |
| **STEM Challenges** | **Science Probes*** Batteries, Bulbs, and Wires
* Magnets in Water
* Talking About Forces
 | **Picture Perfect Sci*** Magnetic Dog
 |  **Mystery Science** |
| **ASSESSMENT** |
| Students add new details to graphic organizer from engage phase. Anticipate/support students toward the following:

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| **white-blue** | No color |
| Static | Current |
| Build-up of electrons | Bumping electrons |
| Occurs naturally, usually because of friction | Requires conductors, things (matter) with electrons ready to jump around |
| Occurs quickly | Magnets can strengthen electric force; like an electromagnetic generator in power plants |
| Stops interacting with matter when the charges are neutral | Requires a closed circuit to make something turn “on” or “work” |

After students have agreed upon their distinguishing factors for static and current electricity, present them with a new scenario/problem. Provide time for students to construct an explanation to the phenomenon, as well as, explain a possible solution.*New Scenario: Yesterday when my mom plugged in the vacuum cleaner, the outlet sparked. It left a black mark on the outlet and then the outlet wouldn’t work. So, my mom plugged the vacuum into a different outlet, and it worked safely.* What might have caused the outlet to spark when my mom tried to plug in the vacuum?What could you do to easily fix the outlet (with the help/supervision of an adult)? | * Students develop final models of Earth’s magnetic field to include labels/explanations of the following:

-role of electric current through Earth’s core-motion of various matter that is part of Earth’s composition-phases of various matter that is part of Earth’s composition-approximate location of geographic poles versus geomagnetic poles-caption that explains how each label collectively constructs an explanation of earth’s magnetic field.Bonus Labeling/Possible Explanation in Caption: Include the migration pattern of a bird that migrates through Georgia. |
| **Differentiation:** \*\*Click on full versions of lessons listed above for specific suggestions for differentiation |

**APPENDIX A**

**Disciplinary Core Idea: Physical Science Learning Progression**

**Electricity & Magnetism**

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| 1st Grade | 5th  | 8th | High School Physical Science |
| S1P2. Obtain, evaluate, & communicate information to demonstrate the effects of magnets on other magnets & other objects. a. Construct an explanation of how magnets are used in everyday life. (Clarification statement: Everyday life uses could include refrigerator magnets, toys, magnetic latches, and name tags.) b. Plan and carry out an investigation to demonstrate how magnets attract and repel each other and the effect of magnets on common objects. | S5P2. Obtain, evaluate, and communicate information to investigate electricity. a. Obtain and combine information from multiple sources to explain the difference between naturally occurring electricity (static) and human-harnessed electricity. b. Design a complete, simple electric circuit, and explain all necessary components.c. Plan and carry out investigations on common materials to determine if they are insulators or conductors of electricity. S5P3. Obtain, evaluate, and communicate information about magnetism and its relationship to electricity. a. Construct an argument based on experimental evidence to communicate the differences in function and purpose of an electromagnet and a magnet. (Clarification statement: Function is limited to understanding temporary and permanent magnetism.) b. Plan and carry out an investigation to observe the interaction between a magnetic field and a magnetic object. (Clarification statement: The interaction should include placing materials of various types (wood, paper, glass, metal, and rocks) and thickness between the magnet and the magnetic object.) | **S8P5. Obtain, evaluate, and communicate information about gravity, electricity, and magnetism as major forces acting in nature.** a. Construct an argument using evidence to support the claim that fields (i.e., magnetic fields, gravitational fields, and electric fields) exist between objects exerting forces on each other even when the objects are not in contact.b. Plan and carry out investigations to demonstrate the distribution of charge in conductors and insulators. (Clarification statement: Include conduction, induction, and friction.) c. Plan and carry out investigations to identify the factors (e.g., distance between objects, magnetic force produced by an electromagnet with varying number of wire turns, varying number or size of dry cells, and varying size of iron core) that affect the strength of electric and magnetic forces. (Clarification statement: Including, but not limited to, generators or motors.) | **SPS10. Obtain, evaluate, and communicate information to explain the properties of and relationships between electricity and magnetism.** a. Use mathematical and computational thinking to support a claim regarding relationships among voltage, current, and resistance. b. Develop and use models to illustrate and explain the conventional flow (direct and alternating) of current and the flow of electrons in simple series and parallel circuits. (Clarification statement: Advantages and disadvantages of series and parallel circuits should be addressed.) c. Plan and carry out investigations to determine the relationship between magnetism and the movement of electrical charge. (Clarification statement: Investigations could include electromagnets, simple motors, and generators.) |

**APPENDIX B**

**Science and Engineering Practices:** Based on the fourth quarter standards, there may be a gap in the understanding of the following Science and Engineering Practices:

# Obtaining, Evaluating, and Communicating Information: Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.



**Cross-Cutting Concepts:**

