Sixth Grade Science Curriculum

Unit: Electromagnetic Force	Time: September-December	Standards:
Essential Questions • How do multiple forces affect motion? • What factors affect the force of attraction between magnets? • What is required to complete an electric circuit? • What modifications to an electromagnet will affect the strength of its magnetic field? • How can we generate electrical energy?	**Enduring Understandings** • I can use my understanding of forces to explain the different ways forces affect motion. • I can explain the factors that affect the force of attraction between magnets. • I can experiment with different materials to determine what is necessary to complete an electric circuit. • I can use my understanding of electromagnetism to modify the strength of an electromagnetic field. • I can explain the materials and construction necessary to generate electrical energy.	MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. 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. MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. MS-ETS1-1: Define the criteria constraints of a design problem with sufficient precision to ensure a successful solution taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-4 Construct an argument supported by evidence for how increases in human population per-capita consumption of natural resources impact Earth's systems.
Benchmark Assessment(s) ➢ SWBAT brainstorm different variables that might affect the strength of their electromagnet, and then test those variables. Working as a class, they will combine their results to determine the best design for an electromagnet. (MS-PS2-2, MS-PS2-3, MS-PS2-5, MS-PS3-2, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4) ➢ SWBAT observe a generator and compare its components and function to a motor. They will explain the interactions in terms of energy transfer. They will consider energy for human electricity use and use solar cells to power an electric motor. Students will also read about human energy sources, including resource limitations and consequences. Students will compare and contract information from observations and information gained from the text as well analyze the structure of the text. (MS-PS3-5, MS-ESS3-3, MS-ESS3-4, RST.6-8.5, RST.6-8.9, RST.6-8.10)		**Other Assessments** ✓ Embedded science notebook worksheets ✓ Embedded science notebook quick writes ✓ Student Reference book questions ✓ Focus question responses ✓ Pre-assessment surveys ✓ Microscope parts assessment ✓ Formal Investigation Check assessments **Materials** • www.fossweb.com • Student resource book • Teacher resource book • Investigation 1 materials TM pgs 84, pg 99, pg 108 • Investigation 2 materials TM pgs 140, 150, 168 • Investigation 3 materials TM pgs 196, 216, 232 • Investigation 4 materials TM pgs 258, 269, 291

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SUGGESTED ACTIVITIES

- Investigation 1 parts 1, 2, 3: Push and Pull, Friction, Forces in Action
    - Students will use a variety of materials (spring scales, loads, plastic cars, rubber bands) to understand the force that is needed to push or pull an object, how friction impacts the force needed, how mass impacts the amount of force needed to move an object, and how a difference in the amount of force applied to an object results in motion.
- Investigation 2 parts 1, 2, 3: Properties of Magnets, Magnetic Fields, Force over Distance
    - Students will experiment with different objects to learn which materials stick to magnets. They will also complete experiments to learn about magnetic poles, magnetic fields, and how to create a temporary magnet.
- Investigation 3 parts 1, 2, 3: Building a Circuit, Building an Electromagnet, Improving the Design
    - Students will learn how to create a complete circuit through using a D-cell, wires, and a lightbulb. Students will continue to experiment with various materials to figure out the relationship between electricity and magnetism. Additionally, students will brainstorm different variables that might affect the strength of their electromagnet and test the variables. Discuss the author's purpose by providing details on how to complete the experiment (RST.6-8.6)
- Investigation 4 parts 1, 2, 3: Electric Motors, Electric Generators, Force and Energy
    - Students will operate an electric motor in a circuit, dissect a motor, and explain how it works after analyzing its components. Students will also observe a generator and compare its components and function to a motor.

REINFORCEMENT

- Provide printed notes, organizers, charts, etc. for student notebooks.
- Have students use post-it notes/highlighters to mark key points in notebooks/materials.
- Provide note cards for vocabulary terms.
- Multi-media Interactive Activities – Foss Teacher Page/Digital Only Resources/Multi-media – Magnetism
- Multi-media Interactive Activities – Foss Teacher Page/Digital Only Resources/Multi-media – Forces

ENRICHMENT

Magnets to Record Digital Data – Enrichment Activity

Magnetic disk drives are used to store and retrieve information for many different applications. How are all these different kinds of information stored on magnetic disk drives? Information like words, music, pictures, or movies is translated into a format that can be saved onto various permanent storage devices, like a magnetic disk drive. This translation is called *digitization*, which means that the information is converted into a stream of numbers. The smallest unit for digital information is called a ***bit***. A bit can be either 0 or 1. Students will digitize a short piece of text (any 3-letter name or word you want) using the ASCII representation of the text.

You will need a three letter word, name, or acronym to digitize. It can be anything you want. Make a table, in your lab notebook, to translate your chosen word or phrase into the binary ASCII code. You can find a list showing the binary ASCII code for all letters. For example, if we chose "Jem" as our Now use individual bar magnets to represent each bit of the coded word. Tape several pieces of paper together lengthwise. Using your ruler to measure, draw 24 rectangles. Each rectangle should be 2 inches long (left to right) and 1 inch wide (up and down). We will say that a magnet with its N pole facing right is a 1, and a magnet with its N pole facing left is a 0. (To make your code easier to see, you may want to color the N half of each magnet.) Place one magnet in each rectangle on your paper, arranging them according to the binary code for your word or phrase.

What is the information density of your recording? How many bits per square inch? Record your calculation in your lab notebook. Just for comparison, a 1990 hard disk could store 1 billion (1,000,000,000) bits per square inch, and a 2006 hard disk can store 100 billion (100,000,000,000) bits per square inch. Square inches are calculated by multiplying the number of rectangles on your paper by the length of each rectangle by the width of the each rectangle. For example, 24 rectangles x 2 inches length x 1 inch width = 48 square inches. Every 1/0 is a bit. Since every 1/0 is represented by a magnet you can count the total number of magnets in order to calculate the number of bits. Bits per square inch is the total number of bits divided by the total square inches.

Gently jiggle your paper. What happens to the arrangement? Are some of the magnets attracted (or repelled) by their neighbors? Did something like this happen to your magnets? If the magnetic

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material on a recording surface could move around like your bar magnets, how do you think this would affect the durability of the recording?

Create a new set of rectangles, on paper, for your magnets. Keep the width 1 inch and decrease the length of the rectangle to 1 ¾ inches. What is the information density now? Do the magnets interact with their neighbors (without you jiggling the paper) or stay separated? Each time, decrease the length of the rectangle by ¼ inch and record your calculations and observations in your lab notebook. How small can your squares be without the magnets interacting with their neighbors? What is the highest recording density (in bits per square inch) you can achieve?

Once you have found the highest recording density possible with your bar magnets, arrange the magnets on your paper again using that rectangle size. Take the horseshoe magnet and, holding it a foot above the paper (measure with the ruler), pass it over the bar magnets. Did any of the bar magnets move? If the bar magnets did not move, lower the horseshoe magnet slightly and try again. At what height does the horseshoe magnet move the bar magnets? If the bar magnets did move, raise the horseshoe magnet slightly and try again. At what height does the horseshoe magnet first stop moving the bar magnets? Record your observations in your lab notebook.

Cross-Curricular Connections

21st Century Skills - *Throughout this unit there are many labs that give the students materials and require them to create circuits and electromagnetic fields. Students will need to demonstrate creativity and innovation to use their materials to be successful in these situations. In addition, students will need to utilize critical thinking to make sense of problems and persevere in solving them. (CRP6 & CRP8)*

Technology- *During investigations 1, 2, & 3, students are required to develop data tables and determine the averages of the data they collect. They must use the data tables to identify relationships and to summarize their findings. 8.1.8.A.4*

SEL- *As students work with their peers in lab groups, they need to focus on their Social Awareness and Relationship Skills. Students will learn to respond appropriately to one another when they have differing opinions or strategies for completing labs. Students will need to be respectful of one another's viewpoints and adjust their social interactions to create a positive and productive environment for all group members.*

Language Arts or Math

LA-

- *Students will use Language Arts standards for informational texts when they work in their student resource books.*
  - *RI.6.2. Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.*
  - *RI.6.3. Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes).*
- *Students will use Language Arts standards for writing when they answer focus questions, complete quick writes, and complete their lab response sheets.*
  - *NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.*
- *Students will conduct research investigations each time they complete a lab.*
  - *NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.*
- *Students will need to work appropriately with one another in their lab groups and address one another respectfully in group and class discussions.*
  - *SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.*

Math-

- *During investigations 1, 2, & 3, students are required to develop data tables and determine the averages of the data they collect*
  - *6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.*

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Unit: Diversity of Life

Time: January- April

Standards:

MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to function.
MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

Essential Questions

- How can we evaluate if something is living or nonliving?
- What microscopic structures make up organisms?
- What are the building blocks of cell structures?
- How do the structural adaptations of seeds help them survive?

Enduring Understandings

- I can use my understanding of the characteristics of living and nonliving things to determine if something is living or nonliving.
- I can use a microscope to identify and explain the structures that make up various organisms.
- I can explain the function of the structures that make up cells.
- I can identify and explain the structural adaptations of seeds that allow them to survive.

Benchmark Assessment(s)

- SWBAT use a microscope to study the behaviors of brine shrimp, elodea, paramecium, and cheek cell. Observe, label, and explain the different components of each organism. (MS-LS1-1, MS-LS1-2, MS-LS1-3, RST.6-8.3)
  - Is it made of a single cell or multiple cells?
  - What structures are visible and what are the functions of those structures?
- SWBAT dissect and label both a lima bean and a flower to identify the parts that allow a plant to successfully reproduce and grow. (MS-LS1-4, MS-LS1-5)
- SWBAT observe and explain the process of the cycle of matter, energy flow, and how food is rearranged through conducting an experiment with a celery stalk. (MS-LS-6)
  - Observe the water flow through a stalk of celery using colored dye.
  - Remove xylem from celery, create wet mount, and observe the stomata in plant leaves.
- SWBAT understand the processes of photosynthesis and transpiration through reading student text (pgs 35-39) and completing corresponding questions. (MS-LS-7, RST.6-8.4, RST.6-8.1)

Other Assessments

- ✓ Embedded science notebook worksheets
- ✓ Embedded science notebook quick writes
- ✓ Student Reference book questions
- ✓ Focus question responses
- ✓ Pre-assessment surveys
- ✓ Microscope parts assessment
- ✓ Formal Investigation Check assessments

Materials

- www.fossweb.com
- Student resource book
- Teacher resource book
- Investigation 1 materials TM pgs 64, 80
- Investigation 2 materials TM pgs 110, 121, 130
- Investigation 3 materials TM pg 152, 162, 175, 183
- Investigation 4 materials TM pgs 218, 237, 258, 68
- Investigation 5 materials TM pg 292, 302, 313
- Investigation 6 materials TM pg 339, 347, 359, 372
- Science Court DVD & worksheets

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SUGGESTED ACTIVITIES

- Science Court activities
  - Students follow along with DVD and develop arguments about whether or not something is living, nonliving, or dead.
- Investigation 1 parts 1&2 activities: Living or Nonliving, Is Anything Alive in Here?
  - Students will spend this investigation learning the characteristics of living vs. nonliving things. They will observe different materials to see how they respond in different environments and document the evidence that supports their findings.
- Investigation 2 parts 1&2 activities: Meet the Microscope, Field of Few
  - Students will learn the parts of a microscope and how to operate the microscope. They will understand the diameter of the field of view and use it to estimate the size of various organisms.
- Investigation 3 parts 1, 2, 3, 4 activities: Discovering cells, Paramecia, Microworlds, Human Cheek tissue
  - Students will use microscopes to observe elodea and paramecium to identify parts and sexual behaviors.
- Investigation 4 parts 1, 2, 3, 4 activities: Comparing Living Things, Bacteria, Fungi, Archea
  - Students will test various surfaces for bacteria using inoculation techniques. They will then student the structures and functions of bacterial cells.
- Investigation 5 parts 1, 2, 3 activities: What Happened to the Water?, Looking at Plant Structures, Transpiration and Photosynthesis
  - Students will complete an investigation to find out what happens to water when a stalk of celery sits in a vial of water overnight. Students will use this experiment to learn about the vascular system of a celery stalk. They continue to experiment with the celery to understand the processes of photosynthesis and transpiration.
- Investigation 6, parts 1, 2, 3, 4 activities: Lima Bean Dissection, Environmental and Genetic Factors, Flowering-Plant Reproduction, Flowers and Pollinators
  - Students will dissect lima beans to learn about structural adaptations that allow seeds to germinate. They will also investigate how increasing the salinity of water affects the germination and growth of food crops. Additionally, they will dissect flowers to learn about flower structures and sexual reproduction.

REINFORCEMENT

- Provide printed notes, organizers, charts, students, etc. for student notebooks.
- Have students pair-up with partner to share answers to focus questions
- Have students use post-it notes/highlighters to mark key points in notebooks/materials.
- Multi-media Interactive Activities – Foss Teacher Page/Digital Only Resources/Multi-media – Microscope Measurements

ENRICHMENT

Bioblitz – Enrichment Activity
Students watch "Secret Garden," a video that takes an amusing look at the life that exists "behind the scenes" in a British yard. Students explore their own locale to collect plants and animals and discover the unexpected diversity of life that exists.
See Foss Teacher Pages – Investigation 8 – Part One / Bioblitz – Teacher Masters NN, OO, PP
Extensions: View Video – "Bioblitz, San Francisco 2014" – Foss Teacher Pages – Investigation 8 - Extensions

Cross-Curricular Connections

21st Century Skills- *While working with microscopes throughout this unit, students will need to apply appropriate academic and technical skills in order for their labs to be successful. (CRP2) As students work with their groups throughout all of their labs, they must communicate clearly and effectively and with reason. They must be able to respectfully discuss their ideas and present suggestions. (CRP4)*

Technology- *When working with different environments and living vs. nonliving things, students observe different materials in different environments to see what environments allow for the successful development of dormant organisms. They must develop theories and test their theories using different environments. 8.1.8.A.4*

SEL- *As students work with their peers in lab groups, they need to focus on their Social Awareness and Relationship Skills. Students will learn to respond appropriately to one another when they have differing opinions or strategies for completing labs. Students will need to be respectful of one another's viewpoints and adjust their social interactions to create a positive and productive environment for all group members.*

Language Arts or Math

- *Students will use Language Arts standards for informational texts when they work in their student resource books.*

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- *RI.6.2. Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.*
- *RI.6.3. Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes).*

- *Students will use Language Arts standards for writing when they answer focus questions, complete quick writes, and complete their lab response sheets.*
  - *NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.*
- *Students will conduct research investigations each time they complete a lab.*
  - *NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.*
- *Students will need to work appropriately with one another in their lab groups and address one another respectfully in group and class discussions.*
  - *SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.*

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Unit: Weather and Water	Time: May-June	Standards:
Essential Questions • How can we measure weather? • What is atmosphere? • How do gases flow in the atmosphere?	**Enduring Understandings** • I can use a variety of tools to measure the different aspects of weather. • I can study the Earth's atmosphere and explain its composition. • I will observe a convection chamber to be able to explain how gases flow in the atmosphere.	MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climate. MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Benchmark Assessment(s)

- SWBAT view video segments of severe weather and generate inquiry questions stimulated by the video and discussions. Students will understand that meteorology is the science of weather. (MS-ESS2-4, MS-ESS3-2, RST.6-8.7)
- SWBAT view local weather reports and determine the factors that combine to produce what we know as weather. They will use a digital weather center to measure temperature, air pressure, and humidity. They will use the tools to acquire daily data for their local site, and use media tools to track weather in another city. (MS-ESS2-4, MS-ESS2-5)
- SWBAT explain convection in liquids as a mechanism for energy transfer through observing the interaction of colored water at different temperatures to determine that warm air rises and cold air descends. (MS-PS1-4, MS-ESS2-6, MS-PS3-4)

Other Assessments

- ✓ Embedded science notebook worksheets
- ✓ Embedded science notebook quick writes
- ✓ Student Reference book questions
- ✓ Focus question responses
- ✓ Pre-assessment surveys
- ✓ Microscope parts assessment
- ✓ Formal Investigation Check assessments

Materials

- www.fossweb.com
- Student resource book
- Teacher resource book
- Investigation 1 materials TM pgs 63, 74
- Investigation 2 materials TM pgs 100, 112
- Investigation 4 materials TM pgs 117, 193, 207

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SUGGESTED ACTIVITIES

- Investigation 1 parts 1&2: Into the Weather, Local Weather
  - Students will view videos to learn that weather is the condition of Earth's atmosphere at a given time in a given place. They will also learn that meteorology is the science of weather, and meteorologists are the people who study Earth's weather. Additionally, they will learn the difference between weather and climate. Students will have a discussion about the difference between facts, reasoned judgments based on research findings and speculation when it comes to weather. (RST.6-8.9)
- Investigation 2 parts 1&2: The Air around Us, Earth's Atmosphere
  - Students will conduct experiments to learn that air is matter that occupies space, has mass, and can be compressed. They will use a particle model to understand the layers of gas surrounding Earth.
- Investigation 4 parts 1, 2, 3: Density of Fluids, Convection in Water, Convection in Air
  - Students will conduct experiments with different solutions to determine their densities in order to understand how materials of densities interact. They will use this knowledge and information from the text to be able to explain the process of convection. (RST.6-8.2)

REINFORCEMENT

- Provide printed notes, organizers, charts, students, etc. for student notebooks.
- Have students pair-up with partner to share answers to focus questions.
- Vocabulary matching game using note cards
- Multi-media Interactive Activities – Foss Teacher Page/Digital Only Resources/Multi-media – Reading Weather Maps
- Show video: Climate Change – Foss Teacher Page/Digital Only Resources/Streaming Video

ENRICHMENT

Earth and Mars' Topography– Enrichment Activities

Earth vs. Mars: What similar physical processes occur on both Earth and Mars?

In this activity, students work in pairs to compare and contrast the physical processes that may be inferred through the observation of images of both Mars and Earth. They will discuss the processes that have occurred on the Earth and the outcomes that have resulted, and transfer this knowledge to the interpretation of the processes that may have occurred on Mars. Looking at pictures from the surface of Mars (https://www.nasa.gov/mission_pages/msl/images/index.html) have students generate hypothesis of how those formations were formed. Was there liquid flow, seismic forces, erosion due to wind or precipitation?

This activity provides an opportunity for the student teams to further their knowledge about the physical processes that shaped both Earth and Mars. They will gain skills in observing the images by analyzing the images to determine which features are older http://ares.jsc.nasa.gov/education/activities/destmars/destmarsLes4.pdf

Present students with the concept terraforming. Ask teams of students to create a topographic 3–D map of a section of the surface of Mars. They may then add elements that would be created during terraforming. Have students to debate the pros and cons of terraforming Mars.

Cross-Curricular Connections

21st Century Skills *- Throughout this unit there are many labs that give the students materials and require them to create circuits and electromagnetic fields. Students will need to demonstrate creativity and innovation to use their materials to be successful in these situations. In addition, students will need to utilize critical thinking to make sense of problems and persevere in solving them. (CRP6 & CRP8)*

Technology- *During investigations 1, 2, & 3, students are required to develop data tables and determine the averages of the data they collect. They must use the data tables to identify relationships and to summarize their findings. 8.1.8.A.4*

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Language Arts or Math

LA-

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- *Students will use Language Arts standards for informational texts when they work in their student resource books.*
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Math-

- *During investigations 1, 2, & 3, students are required to develop data tables and determine the averages of the data they collect*
  - *6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.*

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