Unit 06: Electromagnetism (6 Weeks)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **FY**
Status: **Published**

Standards Alignment

New Jersey Student Learning Standards

PS2: Motion and Stability: Forces and Interactions
PS2.B: Types of Interactions

Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

PS2.C: Stability and Instability in Physical Systems

…and “electrical energy” may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)

PS3: Energy
PS3.B: Conservation of Energy and Energy Transfer

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4)

SCI.3-PS2	Motion and Stability: Forces and Interactions
SCI.4-PS3	Energy
SCI.3.PS2.B	Types of Interactions
SCI.4.PS3.B	Conservation of Energy and Energy Transfer
SCI.HS-PS2	Motion and Stability: Forces and Interactions
SCI.HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
SCI.HS-PS3	Energy
SCI.HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Integration of Career Readiness, Life Literacies and Key Skills

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Technology / Integration of Computer Science and Design Thinking

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.D	Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.
TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math Section

LA.K-12.NJSLSA.R	Reading
	Craft and Structure
LA.K-12.NJSLSA.R4	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
	Integration of Knowledge and Ideas
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
LA.K-12.NJSLSA.W	Writing
	Text Types and Purposes
LA.K-12.NJSLSA.W1	Write arguments to support claims in an analysis of substantive topics or texts, using valid

	reasoning and relevant and sufficient evidence.
LA.K-12.NJSLSA.W3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
LA.RI.11-12.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
	Production and Distribution of Writing
LA.K-12.NJSLSA.W4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.RI.11-12.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
LA.W.11-12.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
LA.W.11-12.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
LA.W.11-12.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media LiteracyNew Section

see Crosswalks

21st Century Life and Careers

CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

Stage I: Desired Results

Transfer/Overview/Rationale

Transfer / Overview / Rationale

Unit Rationale

The purpose of this unit…

Circuits make computers, digital cameras, and video games possible. Along with magnetic fields, circuits are the key components in generating and using electrical power.

Meaning

Essential Questions

Essential Questions

1. How can the flow of water be used to demonstrate Kirchhoff's rules?
2. How do magnetic fields influence the motion of charged particles?
3. How many motors and generators do you use?

Enduring Understanding/Indicators of Understanding

Enduring Understanding/Indicators of Understanding

Students will understand that:

1. Kirchhoff's rules are an application of conservation of charge and energy.
2. Electrostatics and magnetism are two parts of a single electromagnetic force.
3. Electric currents can be used to produce magnetic fields, magnetic fields can be used to produce electric currents.

Acquisition (Student Learning Objectives)

Knowledge

Knowledge

Students will know…

- Electric charge is conserved. The net charge of a system is equal to the charges of all the objects in the system.
- Matter has a property called resistivity.
- Kirchhoff's loop rule describes conservation of energy in electrical circuits.
- The potential difference about any closed loop must add to zero.
- Kirchhoff's junction rule describes the conservation of electric charge in electrical circuits.
- Since charge is conserved, current must be conserved at each junction in the circuit.
- The magnetic field exerts a force on a moving electrically charged object.
- The magnetic field vectors around a straight that wire carries electric current are tangent to concentric circles centered on that wire.
- A magnetic dipole placed in a magnetic field will tend to align with the magnetic field vector.
- Ferromagnetic materials contain magnetic domains that are themselves magnets.
- A magnetic force results from the interaction of a moving charged object or a magnet with other moving charged objects or another magnet.
- Electromagnetic forces are exerted at all scales and can dominate at the human scale.
- Changing magnetic flux induces an electric field that can establish an induced emf in a system.

Skills

Skills

Student will be skilled at …

- Making claims about natural phenomena based on conservation of electric charge.
- Making predictions using conservation of electric charge in simple circuits.
- Choosing and justifying the selection of data needed to determine the resistivity for a given material.
- Constructing or interpreting a graph of energy changes within a circuit.
- Applying conservation of energy concepts to the design of an experiment that will demonstrate the validity of kirchhoff’s loop rule.
- Applying conservation of energy in calculations involving the total electric potential difference for complete circuit

loops.

- Applying conservation of electric charge to the comparison of electric current in various segments of a circuit.
- Designing an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed.
- Using a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.
- Applying mathematical routines to express the force exerted on a moving charged object by a magnetic field.
- Creating a verbal or visual representation of a magnetic field around a long straight or a pair of parallel wires.
- Describing the orientation of a magnetic dipole placed in a magnetic field.
- Using the representation of magnetic domains to qualitatively analyze the magnetic behavior of a bar magnet composed of ferromagnetic material.
- Using the right-hand-rule to analyze a situation involving a current carrying conductor and a moving electrically charged object to determine the direction of the magnetic force.
- Connecting the strength of electromagnetic forces with the spatial scale of the situation, the magnitude of the electric charges, and the motion of the electrically charged objects involved.
- Using representations and models to qualitatively describe the magnetic properties of some materials that can be affected by the magnetic properties of other objects in the system
- Constructing an explanation of the function of a simple electromagnetic device in which an induced emf is produced by either a changing magnetic flux or a changing area.

Stage 3: Learning Plan

Resource and Mentor Texts

Resources and Mentor Texts

- Giancoli, D.C. Physics: Principles with Applications. Englewood Cliffs, NJ: Pearson Education.
- New Jersey Center for Teaching and Learning
- Hieggelke, Curtis, David Maloney, and Stephen Kanim. Newtonian Tasks Inspired by Physics Education Research: nTIPERs. Upper Saddle River, NJ: Pearson, 2012
- PhET Interactive Simulations https://phet.colorado.edu/en/simulations/category/physics
- Cunningham, Herr, Hands On Physics Activities with Real World Applications
- Bilash, Maiullo A Demo a Day, A year of Physics Demonstrations
- Lewin Lectures on Physics
- Flipping Physics
- Doc Schuster Physics Videos

Formative Assessment Strategies

Formative Assessment Strategies

- Hand Signals - students use hand signals to indicate their understanding
- Misconception Check - students are presented with a common misconception about a concept and then asked to agree or disagree and explain why.
- Student Conference - one on one conversation with students to check for understanding
- Observation - observe students as they work to check for learning
- Choral Response - students respond verbally at the same time in response to a question
- Debriefing - students reflect on their work immediately following an activity
- Topic Assessment - short quiz to test a single topic

Learning Activities/Unit of Study

Learning Activities/Unit of Study

- Lecture
- Demonstrations
- Practice Problems -
- Informal activities - students manipulate materials to study a physical concept
- Inquiry Based Activities - students are presented a situation and must design and test their own solution
- Experimental Investigations - students follow a set procedure for studying a physical concept
- PhET Interactive simulations using chromebooks
- Review and practice skills using a variety of materials - (text, workbook, chromebook, games, activities, discussion)

Modifications and/or Accommodations

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This

could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.