Englewood Public School District
Science
Physics
Fourth Marking Period

Unit 4: Electricity and Magnetism

Overview: In this unit of study, students' understanding of how forces at a distance can be explained by fields, why some materials are attracted to each other while other are not, how magnets or electric currents cause magnetic fields, and how charges or changing magnetic fields cause electric fields. The crosscutting concept of *cause and effect* is called out as an organizing concept. Students are expected to demonstrate proficiency *in planning and conducting investigations and developing and using models*.

Time Frame: 40 to 45 days

Enduring Understandings:
Coulomb's Law provides the mathematical models to describe and predict the effects of electrostatic forces between distant objects.
Forces at a distance are explained by fields that permeate space and can transfer energy through space.
Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
When two objects interacting through a field change relative position, the energy stored in the field is changed.

Essential Questions:
How can one explain and predict the interactions between objects and within a system of objects?
What are the relationships between electric currents and magnetic fields?
How can I exert a force on an object when I can't touch it?
How far away can my finger be from someone if I want to zap them with static electricity?

Standards	Topics and Objectives	Activities	Resources	Assessments
(HS-PS2-4) **Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.** **(HS-PS2-5)** **Plan and conduct an investigation to provide evidence that an electric**	**Topics** Static Electricity Electric Fields Current Electricity Circuits Magnetic Fields	Students will complete hands on activities and labs for the following topics: 1. Electroscope 2. Ohm's Law 3. DC series wiring 4. DC Parallel wiring 5. RC circuit 6. Magnetic fields around wires 7. Magnetic field of a solenoid	**Text:** • Glencoe Science: Physics Principals and Problems **Materials:** For the Electroscope activity: • Electroscope • Electrostatic Materials For Ohm's Law, DC series wiring, DC Parallel wiring, RC circuit, Magnetic fields around	**Formative Assessments:** • Student prior knowledge will be evaluated after completing the *Launch Labs.* • Student portfolios will be used to monitor progress. **Summative Assessments:** • Student needs will be

current can produce a magnetic field and that a changing magnetic field can produce an electric current.

(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.

Electromagnetic Induction

Twenty-First Century Themes and Skills include:

- The Four C's
- Life and Career Skills
- Information and Media literacy

Objectives

Students will:

Use mathematical representations of Coulomb's Law to predict the electrostatic forces between two objects in systems with two objects.

Plan and conduct an investigation individually and collaboratively to produce data that can serve as the basis for evidence that an electric current can produce a magnetic field.

Plan and conduct an investigation individually and collaboratively to produce data that can serve as the basis for evidence that a changing magnetic field can produce an electric current.

Develop and use an evidence-based 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.

Students will complete Chapter Launch Labs (see pgs. 541, 563, 591, 617, 643, and 671) to introduce concepts.

Students will watch The Science of Static Electricity and Electric Vocabulary and participate in an online quiz and discussion (NJSLSA.W8)

Student will use a series of interactive models and games to explore electrostatics in the Electrostatics and Electric Field Hockey simulations. (NJSLSA.W9)

Student will graphically analyze equations related to voltage and Coulombs Law in the simulation Graphical Relationships in Electric Fields.

Students will move point charges around on the playing field and then view the electric field, voltages, equipotential lines, and more in the Charges and Fields simulation. (N-Q.A.2, NJSLSA.W7)

Students will explore the relationships between voltage, current, and resistance that make up Ohm's Law using molecular models of circuits in the Electric Current simulation. (N-Q.A.3, MP.4)

Students will explore DC circuits in the Parallel Resistances, Series Resistances, wires, and Magnetic field of a solenoid

- Pasco electrical components

For Chapter Launch Labs (see pgs. 541, 563, 591, 617, 643, 671)

- Plastic ruler
- Piece of wool
- 15-20 scraps of paper from a hole punch
- Two balloons
- Two ½-m strings
- Tape
- 1.5-V D-cell battery
- Insulated wire
- Flashlight bulb in socket
- 9-V battery
- 4 insulated copper wires (20-25-cm long)
- Single strands of steel wool
- Knife switch
- Small glass container
- Two bar magnets
- Compass
- Coil of copper wire
- Galvanometer

Websites:

- Electrostatics
- Electric Field Hockey
- Graphical Relationships in Electric Fields
- Charges and Fields
- Electric Current
- Parallel Resistances
- Series Resistances
- Series-Parallel Resistances
- Magnets and

assessed after completion of online simulations.

- Students will receive a grade for completed lab reports generated in the scientific lab notebook.

Benchmark Assessment:
A Common Formative Assessment will be given at the close of this unit to assess students' mastery of the skills identified.

Alternative Assessments:

- Project Designs
- Models
- Checklists
- Graphic Organizers
- Rubrics
- Peer Assessments
- Visual Representations
- Students will use models to evaluate competing design solutions for developing, managing, and utilizing energy.

	Suggest and predict cause-and-effect relationships for two objects interacting through electric or magnetic fields.	and Series-Parallel Resistances simulations (A-SSE.B.3, MP.2) Students will watch the video Monster Magnets and Why Does a Pool Table need a Super Strong Magnet? to introduce the concept of magnetism. Students will explore the interactions between a compass and bar magnet in the Magnets and Electromagnets simulation. (A-SSE.A.1) Students will investigate Faraday's Law and how a changing magnetic flux can produce a flow of electricity! (8.2.12.C.4) **Enrichment Activities:** Student will complete additional textbook Mini Labs. (N-Q.A.1) Students will find the faulted resistor in a simulated circuit in the Troubleshooting DC Circuits simulation. (8.2.12.A.2)	Electromagnets • Faraday's Law **Videos:** • The Science of Static Electricity • Electric Vocabulary • Monster Magnets • Why Does a Pool Table need a Super Strong Magnet? **Enrichment Lesson Plans:** See textbook Mini Labs and Troubleshooting DC Circuits

Accommodations and Modifications:

Students with special needs: Support staff will be available to aid students related to IEP specifications. 504 accommodations will also be attended to by all instructional leaders. Physical expectations and modifications, alternative assessments, and scaffolding strategies will be used to support this learning. The use of Universal Design for Learning (UDL) will be considered for all students as teaching strategies are considered.

ELL/ESL students: Students will be supported according to the recommendations for "can do's" as outlined by WIDA – https://www.wida.us/standards/CAN_DOs/. This particular unit has limited language barriers due to the physical nature of the curriculum.

Students at risk of school failure: Formative and summative data will be used to monitor student success at first signs of failure student work will be reviewed to determine support. This may include parent consultation, basic skills review and differentiation strategies. With considerations to UDL,

time may be a factor in overcoming developmental considerations. More time and will be made available with a certified instructor to aid students in reaching the standards.

Gifted and Talented Students: Students excelling in mastery of standards will be challenged with complex, high level challenges related to the complexity in planning and carrying out investigations and analyzing and interpreting data.

English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
● Pre-teach vocabulary ● Speak and display terminology ● Teacher modeling ● Peer modeling ● Provide ELL students with multiple literacy strategies. ● Word walls ● Use peer readers ● Give page numbers to help the students find answers ● Provide a computer for written work ● Provide two sets of textbooks, one for home and one for school ● Provide visual aides ● Provide additional time to complete a task ● Use graphic organizers	● Provide highlighters to identify important key words ● Utilize modifications & accommodations delineated in the student's IEP ● Work with paraprofessional ● Use multi-sensory teaching approaches. ● Work with a partner ● Provide concrete examples ● Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA). ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).	● Provide opportunities for review ● Using visual demonstrations, illustrations, and models ● Give directions/instructions verbally and in simple written format. Oral prompts can be given. ● Peer Support ● Increase one on one time ● Teachers may modify instructions by modeling what the student is expected to do ● Instructions may be printed out in large print and hung up for the student to see during the time of the lesson. ● Review behavior expectations and make adjustments for personal space or other behaviors as needed. ● Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community	● Extend research outside of class ● Inquiry-based instruction ● Independent study ● Higher order thinking skills ● Adjusting the pace of lessons ● Interest based content ● Real world scenarios ● Student Driven Instruction ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue. ● Collaborate with after-school programs or clubs to extend learning opportunities.

		helping with a project, journal articles, and biographies).	

Interdisciplinary Connections:
Social Studies:
6.1.12.C.3.a: Analyze how technological developments transformed the economy, created international markets, and affected the environment in New Jersey and the nation.

ELA-NJSLS/ELA:
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. WHST.9-12.7 (HS-PS1-3)
NJSLSA.W8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. WHST.11-12.8 (HS-PS1-3), (HS-ETS1-3)
NJSLSA.W9: Draw evidence from literary or informational texts to support analysis, reflection, and research. WHST.9-12.9 (HS-PS1-3), (HS-ETS1-3)

Mathematics:
MP.2: Reason abstractly and quantitatively. (HS-PS1-8), (HS-ETS1-3), (HS-ETS1-4)
MP.4: Model with mathematics. (HS-ETS1-3), (HS-ETS1-4)
N-Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-3)
N-Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-4), (HS-PS2-5)
N-Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-4), (HS-PS2-5)
A-SSE.A.1: Interpret expressions that represent a quantity in terms of its context. (HS-PS2-4)
A-SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-4)

Integration of 21st Century Skills:
9.3.ST-ET.2: Display and communicate STEM information.
9.3.ST.2: Use technology to acquire, manipulate, analyze and report data.

Career Ready Practices:
CRP6: Demonstrate creativity and innovation**.**
CRP4: Communicate clearly and effectively and with reason.
CRP8: Utilize critical thinking to make sense of problems and persevere in solving them.

Integration of Technology Standards NJSLS 8:
8.2.12.A.2: Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.C.4: Explain and identify interdependent systems and their functions.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5) **Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2),(HS-PS3-5)	**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-PS2-5) **PS3.C: Relationship between Energy and Forces** • When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-5) • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)