Dev. Date:
Established 2016-17
Rev. 2018-19
Rev. 2020-21
Rev. 2021-22
Rev. 2022-23

Bayonne High School

Unit 8: Electrostatics, DC Circuits, Electromagnetism

Revised 2022-23

Aligned to the New Jersey Student Learning Standards 2020

Marking Period	Unit Title	Recommended Instructional Days
4	**Electrostatics, DC Circuits, Electromagnetism**	**22**

NJSLS - Science: *Title*	NJSLS - Science: *Performance Expectations*	**Recommended Activities, Investigations, Interdisciplinary Connections, and/or Student Experiences to Explore NJSLS-S within Unit**
Energy, Motion and Stability: Forces and Interactions	**HS-PS3-1:** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.] **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. [Assessment Boundary: Assessment is limited to designing and conducting	

	investigations with provided materials and tools.]	
FOUNDATION Disciplinary: ***Core Idea***	**FOUNDATION Disciplinary:** ***Statement***	
Structure and Properties of Matter, Forces and Motion, Types of Interactions, Conservation of Energy and Energy Transfer, Wave Properties	**HS-PS1.A:** The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. **HS-PS2.A:** Newton's second law accurately predicts changes in the motion of macroscopic objects. **HS-PS2.B:** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. **HS-PS3.A:**Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	**Essential Question/s:** • What does it mean when an object is "charged"? • How can you describe the interactions between electrically charged systems? • How do you represent these interactions visually? • How can you represent these interactions mathematically? • What makes up a circuit? • What is the relationship between electrical and magnetic interactions? **Activity Description:** • **Sticky Tape Activity:** Students investigate electrical interactions between charged objects using sticky tape, aluminum foil, paper, vinyl rod, felt, glass rod and silk. Students find that opposite charges attract and like charges repel and how charges move through conductors and insulators. Students use charge diagrams to represent their findings. Students also qualitatively investigate the relationship between the electrostatic force and distance between charged objects during their experiments. • **Gravitational vs. Electrical Force:** Students discover the similarities and differences between gravitational force and electrical force by writing a report. • **Electroscope Activity:** Students use an electroscope, a charged vinyl rod and a charged acrylic or glass rod to make predictions about

	HS-PS3.A: At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **HS-PS3.B:** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. **HS-PS3.B:** Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems **HS-PS3.B:** Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. **HS-PS4.A:**Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on	whether the leaves of the electroscope will repel or not using the ideas developed in previous electrostatics activities. ● **Oersted's Experiment:** Students use a current carrying wire in a circuit, and two magnetic compasses to observe the induced magnetic field and discuss the conditions necessary for producing the magnetic field. ● **World's Simplest Motor:** Students build a simple motor using a wire loop, a battery and a magnet. Students apply the right and rules for force and field to determine the direction of motion of the motor's loop. ● **Induced Current:** Students observe induced current in wire loops with different number of turns, connected to a sensitive current sensor and a ceramic magnet that is quickly pulled in and out of a loop or dropped through a loop. Students discuss the conditions necessary for producing induced current and the factors that affect the strength of the current induced. Students can further investigate the application of this phenomenon in an electric- generator. ● **Green Technology:** Students will revisit previously developed mechanisms explaining the warming of Earth. After considering these explanations, they will investigate and construct explanations of current technologies that exist to reduce carbon emissions (wind turbines, solar panels, etc.). Explanations will include their previously developed understanding of energy and waves and the newly developed understanding of simple motors and electromagnetism. ● **Nova Sun Lab:** Students will explore solar flares, Earth's magnetic field, the electromagnetic spectrum and how space weather affects Earth.

	the fact that two different sounds can pass a location in different directions without getting mixed up.)	● **Using Infrared Observations to Search for Origins of the Universe:** Students will read and discuss how the universe was formed and how infrared radiation gives us clues about the origins of the universe. **Interdisciplinary Connections: Content: NJSLS:** *Connections to NJSLS – English Language Arts* ● **WHST.9-12.7:** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. ● **WHST.11-12.8:** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. ● **WHST.9-12.9:** Draw evidence from informational texts to support analysis, reflection, and research. ● **SL.11-12.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *Connections to NJSLS – Mathematics* ● **MP.2:** Reason abstractly and quantitatively. ● **MP.4:** Model with mathematics. ● **HSN-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.
FOUNDATION **Science and Engineering Practices:** ***Core Idea***	**FOUNDATION** **Science and Engineering Practices:** ***Statement***	
Planning and Carrying Out Investigations: Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. **Analyzing and Interpreting Data:** Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. **Using Mathematics and Computational Thinking:** Mathematical and computational thinking at the 9–12 builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions,	● 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. ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Use mathematical representations of phenomena to describe explanations. ● Apply scientific ideas to solve a design problem, taking into	

exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. **Construction Explanations and Designing Solutions:** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. **Obtaining, Evaluating, and Communicating Information:** Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.	account possible unanticipated effects. Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	● **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. ● **HSN-Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
FOUNDATION **Crosscutting Concepts:** ***Core Idea***	**FOUNDATION** **Crosscutting Concepts:** ***Statement***	
● **Patterns** ● **Cause and Effect** ● **Systems and System Models** ● **Energy and Matter**	● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.	

	● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.	
Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***	
● Self-Awareness ● Social Awareness ● Relationship Skills	● Recognizing Strengths ● Respect for Others ● Communication ● Social Engagement ● Teamwork	
Assessments (Formative) ***To show evidence of meeting the standard/s, students will successfully engage within:***		**Assessments (Summative)** ***To show evidence of meeting the standard/s, students will successfully complete:***
Formative Assessments: ● Warm-up quizzes, student responses through group work and class discussion		**Benchmarks:** ● District Assessment

	<u>Summative Assessments:</u> ● Electrostatics Test ● Written report based on the Gravitational vs. Electrical Force Activity ● Circuits Test ● Electromagnetism Test ● Written report based on the Green Technology Activity

Differentiated Student Access to Content:
Teaching and Learning *Resources/Materials*

Core Resources	**Alternate Core Resources *IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core Resources**
● Student Chromebooks ● Lab equipment such as circuit kits, etc. ● Course textbook	● Scaffolded Notes ● Leveled physics games and simulations	● Scaffolded Notes ● Google Translate	● Extension Activities ● Leveled physics games and simulations

Supplemental Resources

Technology:
- Schoology
- Investigative Science Learning Environment Physics Videos
- PhET Physics Simulations
- Physics-related and school-appropriate YouTube videos
- Universe and More Physics Games
- https://nj.pbslearningmedia.org/resource/nvsl.sci.space.lpsl/nova-sun-lab-lesson-plan/
- https://nj.pbslearningmedia.org/resource/ess05.sci.ess.eiu.irorigins/infrared-search-for-origins/support-materials/

Differentiated Student Access to Content:
Recommended *Strategies & Techniques*

Core Resources	**Alternate Core Resources *IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core**

● Promote an approach that benefits multiple learning styles exploring phenomena through readings, videos, and collaborative work. ● Establishing proper safety protocols for using specialized equipment and gathering materials. ● Establishing communication protocols for collaborative activities to ensure all students properly communicate and involve every student. ● Demonstrate that the Engineering Design Process is a flexible cycle that allows for steps to be repeated.	● Utilize a multi-sensory approach during instruction, provide multiple presentations of skills by varying the method (repetition, simple verbal explanations, mathematical representations, visual representations, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.	● Utilize a multi-sensory approach during instruction, provide multiple presentations of skills by varying the method (repetition, simple verbal explanations, mathematical representations, visual representations, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.	● Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect students to related talent development opportunities.

NJSLS CAREER READINESS, LIFE LITERACIES & KEY SKILLS	**Disciplinary Concept:** Technology Literacy	
	Core Ideas:	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
	Performance Expectation/s:	9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
	Career Readiness, Life Literacies, & Key Skills Practices	
	Practice: Utilize critical thinking to make sense of problems and persevere in solving them.	***Description:*** Students 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.

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)									
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*		LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*		Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*	x	Standards in Action: *Climate Change*