Montclair Public Schools

Science

Curriculum Guide

Physics Honors Grade 11-12

2013-2014

Approved by the Montclair Board of Education
September 2011/Revised: September 2013

Subject	PHYSICS HONORS	Grade	11-12	Unit #	1	Pacing	8-10 WEEKS
INTRO/KINEMATICS	INTRO/KINEMATICS						

Overview

- Students will learn about the concept of motion and at the end of the unit they will be able to represent both the constant speed and the accelerated motion via graphs and algebraic equations and solve for the unknown physical value while correctly converting and using appropriate units.

Standard #	NJCCCS	SLO #	Student Learning Objectives	Depth of Knowledge
HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	1	• Explain the idea that position and motion is relative to a frame of reference	4
		2	• Represent measurements of different quantities, such as distance and time, with the correct unit and be able to convert into different units properly	4
		3	• Distinguish between speed and velocity and properly classify velocity as a vector quantity	4
		4	• Recognize graphs can represent the motion of an object	4
		5	• Interpret the slope of x-t graph to be the velocity and the area under x-t curve to be the displacement	3
		6	• Use kinematic equations to represent these motion graphs algebraically	2
		7	• Explain and interpret the outcome of the equations that are solved	3
		8	• Argue if these results are with correct	3

			units and within the expected range	
Standard #	CCSS ELA Standard	SLO #	Student Learning Objectives	Depth of Knowledge
RST.11-12.1	• Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	9 10	• Utilize the textbook and suggested resources to support understanding • Use proper equipment to collect data	3 3
RST.11-12.3	• Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	11	• Use lab instructions and background materials to develop a scheme for collection and analysis of data	4
RST.11-12.4	• Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 and 11-12 texts and topics	12	• Define all key vocabulary terms and concepts and review them with the teacher	1
RST.11-12.7	• Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	13	• Make a simple sketch of the problem/lab with the important information presented	2
WHST.9-12.2	• Write informative/explanatory texts, including the	14	• Describe the objective of the lab activity and give a synopsis of the lab	2

	narration of historical events, scientific procedures/ experiments, or technical processes.		activity	
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.	15	• Explain the expected outcomes of each step in an experimental procedure in one's own words making references to main concepts, equations and other relevant sources	3
		16	• Examine the data and compute the unknown desired quantity by using algebraic and graphical methods	2
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.	17	• Type a comprehensive coherent lab/project report that shows the objective, summary (with references made to concepts, articles etc.), data collection, sample calculations, and graphical representation.	4
WHST.9-12.9	• Draw evidence from informational texts to support analysis, reflection, and research.	18	• Compare and argue the experimental results to the expected value and calculate the error	4

Big Ideas: Marshall A.c

1. Mathematical methods are used to represent everyday physical motion
2. Mathematical representation of physics is a convenience to solve them which in return needs to be interpreted back to make sense
3. Motion is relative and could be represented by both equations and graphs
4. It is of interest to know how fast distance is covered and how fast the speed is changing.

Essential Questions: Marshall A.c, C.c

1. What do units represent and how they can be of significance?
2. How could dimensional analysis be used to judge if a solution is correct?
3. How do you distinguish between the following types of motion: constant speed accelerating speed?
4. How would the algebraic and graphical representation of aforementioned types of motion be?
5. Why would both the speed and direction information be essential for airplanes?
6. How do you add or subtract vectors?
7. What information can be extracted from motion graphs?
8. How are the kinematic equations and the graphs of motion are related?
9. Why do we use algebra or graphs to represent daily events?

Assessments: Marshall A.d, D.c

- Formal and informal formative and summative assessments as determined by the teacher
- Common Benchmark as per district schedule

Key Vocabulary

- Unit
- Dimension
- Scalar
- Vector
- Distance
- Displacement
- Speed
- Instantaneous, average
- Velocity
- Acceleration
- Kinematic
- Projectile
- Trajectory

Suggested Resources (CCSS Exemplar Texts in Bold)

http://www.physicsclassroom.com/Class/
http://www.fisica.ufmg.br/~basico/Phys100.html
http://phet.colorado.edu/en/simulations/category/physics

- CCSS Framework Appendix A: Grade Level Text Complexity (p.5)
- CCSS Framework Appendix B: Text Exemplars and Sample Performance Tasks
- CCSS Framework Appendix C: Writing Exemplars

DIFFERENTIATION

Special Education	ELL	RtI
• Modifications & accommodations as listed in the student's IEP • Assign a peer to help keep student on task • Modified or reduced assignments • Reduce length of assignment for different mode of delivery • Increase one to one time • Working contract between you and student at risk • Prioritize tasks • Think in concrete terms and provide hands on tasks • Position student near helping peer or have quick access to teacher • Anticipate where needs will be • Break tests down in smaller increments • NJDOE resources	• Strategy groups • Teacher conferences • Graphic organizers • Modification plan • NJDOE resources • Adapt a Strategy-Adjusting strategies for ESL students: http://www.teachersfirst.com/content/esl/adaptstrat.cfm	• Tiered Interventions following RtI framework • RtI Intervention Bank • Fundations Double-Dose (Tier II) • LLI (Tier III) • FFI Skill Report: DRA On-Line • enVision intervention supports • NJDOE resources

ALIGNMENT TO 21st CENTURY SKILLS AND TECHNOLOGY

21st Century/ Interdisciplinary Themes: Bold all that apply	21st Century Skills: Bold all that apply
Global Awareness Financial, Economic, Business and Entrepreneurial Literacy Civic Literacy Health Literacy **Environmental Literacy**	**Creativity & Innovation** **Critical Thinking & Problem Solving** **Communication & Collaboration** **Media Literacy** **Information Literacy** **Information, Communication & Technology** **Life & Career Skills**

Technology Infusion

- Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others
- Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

Epson Interactive Whiteboard Applications

Evidence of Student Learning

• Common benchmark • Evaluation rubrics	• Teacher-student conferences • Running records	• Students' published work • Unit tests	• Quizzes • Laboratory Investigations

Subject	PHYSICS HONORS	Grade	11-12	Unit #	2	Pacing	10 WEEKS
INTRO/KINEMATICS	Laws of Motion						

Overview

Unit 2 extends the use of vectors to force and free body diagrams. The unit introduces Newton's Laws and details how they govern the motion of objects. Students will measure the effects of forces on everyday objects to develop an understanding of the forces in our universe. The universal forces will be presented and the gravitational force will be investigated in detail. The influence of friction on motion will be determined.

Standard #	NJCCCS	SLO #	Student Learning Objectives	Depth of Knowledge
HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	1	• 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.	4
		2	• Clearly state the laws of motion and identify which ones are at play given a situation	4
		3	• Find the net (resultant) force acting on an object using free-body diagram	4
		4	• Find the net force acting on an object in 2-D and then combine this information with kinematic equations to further analyze and predict the motion	3
		5	• Include the effect of friction in the motion	4

		6 **7**	• Identify action-reaction pairs • Analyze a given complex motion through the laws of motion	3 4
Standard #	CCSS ELA Standard	SLO #	Student Learning Objectives	Depth of Knowledge
RST.11-12.1	• Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	8 9	• Utilize the textbook and suggested resources to support understanding • Use proper equipment to collect data	2 2
RST11-12.3	• Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	10	• Use lab instructions and background materials to develop a scheme for collection and analysis of data	3
RST 11-12.4	• Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 and 11-12 texts and topics.	11	• Define all key vocabulary terms and concepts and review them with the teacher	1
RST 11-12.6	• Analyze the author's purpose in providing an explanation, describing a	12	• Understand how scientists pose and answer questions based on the data available	3

	procedure, or discussing an experiment in a text, defining the question the author seeks to address.			
RST.11-12.7	• Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	13	• Make a simple sketch of the problem/lab with the important information presented	2
WHST.9-12.2	• Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	14	• Describe the objective of the lab activity and give a synopsis of the lab activity	2
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.	15	• Explain the expected outcomes of each step in an experimental procedure in one's own words making references to main concepts, equations and other relevant sources	3
WHST.11-12.8	• Gather relevant information from multiple	16	• Examine the data and compute the	

	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.		unknown desired quantity by using algebraic and graphical methods	3
WHST.9-12.9	• Draw evidence from informational texts to support analysis, reflection, and research.	17 18	• Type a comprehensive coherent lab/project report that shows the objective, summary (with references made to concepts, articles etc.), data collection, sample calculations, and graphical representation. • Compare and argue the experimental results to the expected value and calculate the error	4 3

Big Ideas

- All mechanical motion in the universe could be understood by 3 laws of Motion
- Behind every motion there is the presence or the lack of net forces
- Friction is a dissipative force that retards the motion and depends on normal force and the quality of the surfaces
- By knowing the magnitude and the direction of forces acting on an object(system) one can predict the outcome of the motion at a given time

Essential Questions

- What will happen to an object in space with a constant speed that is not affected by any force?
- What is the resultant of two forces that are acting on an object with an angle q between them?
- Indicate all the forces that acting on a book that is sitting on the table.

- What is the tension of a string that is hanging from the ceiling and a ball of 2 kg attached to its other end? If the string snaps what will be the tension? What will be the acceleration of the ball?
- Identify the action reaction pairs in: a wheel turning on the ground, a horse pulling a carriage, a spaceship firing its engines.
- Describe the motion of a space ship, that is in a remote area in space far from any object, fires its engines until all fuel is used and then turns off the engines? Which laws of motion are at play?

Assessments

- Through the group activities, problem solving sessions, unit tests/quizzes, and homework in the following areas:
  - Has the student developed an understanding of the 3 laws of motion?
  - Can the student determine the resultant of external forces and state the resulting motion
  - Is the student comfortable in interpreting F=ma and apply it to the problem to solve the equations of motion algebraically
- Common Benchmark as per district schedule

Key Vocabulary

- Inertia
- 3 laws of motion
- Free-body diagram
- Net Force
- Action-reaction
- Friction
- Trajectory

Suggested Resources (CCSS Exemplar Texts in Bold)

http://teachertech.rice.edu/Participants/louviere/Newton/
http://science.discovery.com/interactives/literacy/newton/newton.html
http://www.fisica.ufmg.br/~basico/Phys100.html
http://phet.colorado.edu/en/simulations/category/physics (very useful)
resource text site with lots of self check quizzes
http://physicsquest.homestead.com
fantastic everything site from Dolores Gende
http://www.stmary.ws/highschool/physics/
great site with labs and review questions
http://www.glenbrook.k12.il.us/gbssci/phys/class/BBoard.html
The physics classroom with topics for all chapters
http://teachertech.rice.edu/Participants/louviere/Newton/
Newton's Laws
http://www.phy.ilstu.edu/~erosa/newton2law1.doc

Newton's Laws Lab
http://faculty.physics.tamu.edu/roshchin/218/labs-steps/Lab1A_STEPS.pdf
Force Table
http://www.sethi.org/classes/elabs/lab_04.html
Centripetal Force

- CCSS Framework Appendix A: Grade Level Text Complexity (p.5)
- CCSS Framework Appendix B: Text Exemplars and Sample Performance Tasks
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Learning Experiences (last area to be completed)

Instructional Focus	Student Learning Objectives	Assessments
• What can I do to make the work maximally engaging and effective? • What content should we cover? What content needs to be "uncovered"? • When should the "basics" come first? When should they be on a "need to know" basis? • When should I teach, when should I coach, and when should I facilitate student "discovery"? • How do I know who and where the learners are? • In order to truly meet the standard, what should they be able to do independently (transfer)? What should I be doing to make them more independent and able to transfer? • What events will help students practice & get feedback in transfer using the learning in realistic ways?	• List SLOs that are addressed via instructional focus • If listed then they should be taught	Through the group activities, problem solving sessions, unit tests/quizzes, lab reports and homework in the following areas: 1. Has the student developed a sense of linear motion in 1-D? 2. Can the student apply algebraic/trigonometric equations to solve for the components of vectors? 3. Has the student mastered the relationship between the graphical and algebraic representation of the motion? 4. Can the student successfully prepare the lab according to the procedures, and collect, analyze, and present and comment on the data? 5. Can the student work in a group and as a team successfully subdivide a project into components and each member work out one of them, and then connect the pieces to solve the greater problem and successfully present it with a self-evaluation of the entire project

DIFFERENTIATION

Special Education	ELL	RtI
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Subject	PHYSICS Honors	Grade	11-12	Unit #	3	Pacing	10 WEEKS
INTRO/KINEMATICS	Conservation Laws						

Overview

This unit introduces students to the topic of energy and the ideas of energy conservation. The students begin by developing understandings about the different forms of energy (i.e. Kinetic and Potential). Students then connect these concepts to develop an understanding about the law of conservation of energy. Furthermore, the unit provides the students with tools to deepen their knowledge about renewable and non-renewable sources of energy, and how using these sources affect the environment. While studying this unit, the students have the opportunity to make connections between the ideas of conservation of energy and conservation of momentum, especially in the study of elastic collisions. The gas laws from chemistry are reviewed in order to study thermodynamics by looking at heat engines.

Standard #	NJCCCS	SLO #	Student Learning Objectives	Depth of Knowledge
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.	**1**	• Recognize that work is the flow of energy from one form to another	4
		2	• 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.	4
		3	• Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	3
		4	• Define the work done by a constant force, and realize that work is a scalar quantity.	4
		5	• Recognize that the work done by a force can be positive, negative, or zero.	4

HS-PS3-2	• Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles(objects) and energy associated with the relative position of particles(objects)	6 7 8 9	• Define the kinetic energy of a body of mass m traveling with speed v. • Define the concept of power as the rate at which work is done (energy is used/converted in a given time period) • Define the potential energy as a stored energy and associated with the relative position of an object(sub parts of a system) with respect to a reference point(arrangement) • Recognize that the gravitational potential energy function can be positive, negative, or zero.	4 4 4 3
HS-PS3-3	• Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	10 11 12	• Design and build a car that converts stored PE into KE and calculate assigned parameters and compare with the actual data • Mechanical energy is conserved in the absence of net external forces, while KE and PE can be converting to one another and keeping the sum constant • Define the Work-Energy Theorem.	4 4 4

HS-PS3-4	• Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	13	• Investigate the temperature change when liquids at different temperatures are mixed	3
HS-PS2-2	• Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system	14 15	• Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.	3 3
HS-PS2-3	• Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	16	• Using the principles of energy and momentum conservation, design and build a model seat belt/air bag system to protect an egg from breaking during a collision	4

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RST.11-12.7	• Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	18	• Use proper equipment to collect data	3
WHST.9-12.2	• Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	19	• Make a simple sketch of the problem/lab with the important information presented	3
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.	20	• Describe the objective of the lab activity and give a synopsis of the lab activity	3
		21	• Explain the expected outcomes of each step in an experimental procedure in one's own words making references to main concepts.	3
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	22	• equations and other relevant sources	3
		23	• Examine the data and compute the unknown desired quantity by using algebraic and graphical methods	3
		24	• Type a comprehensive coherent lab/project report that shows the objective, summary (with references made to concepts, articles etc.), data collection, sample calculations, and graphical representation.	4

WHST.9-12.9	and following a standard format for citation. • Draw evidence from informational texts to support analysis, reflection, and research.	25	• Compare and argue the experimental results to the expected value and calculate the error	4

Big Ideas

- Energy exists in various forms and can be transformed from one form to another (Law of Conservation of Energy)
- The mechanical energy of a system is the sum of its kinetic and potential energies.
- The total momentum of a system is conserved excluding outside influences
- Heat Energy is used to do work

Essential Questions

- What is Energy?
- What is Work?
- What do we mean by Momentum?
- What is heat?
- What is thermodynamics?
- How do heat engines operate?

Assessments

- Through the group activities, problem solving sessions, unit tests/quizzes, and homework in the following areas:
  - Has the student developed an understanding of the law of conservation of energy
  - Has the student developed an understanding of the law of conservation of momentum
  - Has the student developed an understanding of the laws of thermodynamics
- Common Benchmark as per district schedule

Key Vocabulary

- Potential energy
- Kinetic energy
- Work
- Power
- Efficiency
- Mechanical advantage
- Hooke's Law
- Momentum
- Elastic and Inelastic Collisions
- Laws of thermodynamics

Suggested Resources (CCSS Exemplar Texts in Bold)
TEXT: Glencoe Physics Principles & Problems ISBN 978-0-07-659252-4 Chapters 9-12 all sections **Web-based:** http://www.physicsclassroom.com/Class/ http://www.fisica.ufmg.br/~basico/Phys100.html http://phet.colorado.edu/en/simulations/category/physics http://physicsquest.homestead.com fantastic everything site from Dolores Gende http://www.stmary.ws/highschool/physics/ great site with labs and review questions **http://ocw.mit.edu/courses/physics** **MIT high school open course videos, problems, and more** **Multi-media:** **Video** **Mechanical Universe** **http://www.learner.org.resources/series42.html** **Conservation of Energy** **Conservation of Momentum**

DIFFERENTIATION

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Evidence of Student Learning

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Subject	PHYSICS HONORS	Grade	11-12	Unit #	4	Pacing	10 WEEKS
INTRO/KINEMATICS	E&M and Wave Phenomena						

Overview

- The unit introduces the student to wave motion and properties. General properties of all waves are used as a starting point from which students will electromagnetic waves in more detail. Following the wave introduction students will explore the concepts of electrical charge, conservation of charge, insulators, conductors, and methods of charging objects. Coulomb's Law provides students a way to quantify the electrical forces exerted by charged particles on each other and leads to a discussion of electrical fields. Once the basic introduction to electrical forces and fields is complete students will explore electrical potential energy and voltage. The concept of current as a flow of charge and the way that flow can be manipulated are explored. Power and energy are discussed as well as the actual costs to the consumer. The unit includes magnetism and the association between electrical and magnetic phenomena.

Standard #	NJCCCS	SLO #	Student Learning Objectives	Depth of Knowledge
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.	1	• identify the location and charge of the three basic subatomic particles (electron, proton, and neutron)	4
		2	• Recognize charged object as having an imbalance of protons and electrons, identify the coulomb as the unit of charge, and identify the definition of insulators and conductors.	4
		3	• Identify the connection between the type of charge on an object and the type of interaction (attractive, repulsive, or none) with other objects.	4

		4	• Have a conceptual understanding of Coulomb's law and the factors which effect electrical force.	4
		5	• Use Coulomb's law to calculate the electric force between two objects if given their charges and distance of separation.	4
		6	• Define electric field and recognize the variables which effect (and do not effect) the electric field intensity at a given location	3
		7	• Understand the concept of electric field lines and use their understanding to predict the electric field lines about a point charge or a configuration of point charges	2
HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	8	• Compare and contrast the lattice types of conductors and non-conductors and realize that the ability of electrons to move freely between the lattice sites makes the conduction in a material	3

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.	9	• Using free-body diagram method, and applying Coulomb's and/or Biot-Savart Law identify the forces acting on the two charged particles to find the net force and then predict the motion	3
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.	10 11 12 13	• Recognize current as the rate at which charge flows past a point, identify the units for electric current, and perform simple computations regarding electric current. • Identify the definition of voltage, the units of voltage, and relate voltage to the electric potential difference between two points on a circuit. • Recognize the role of a battery as a charge pump which establishes an electric potential difference across its terminals so that charge can spontaneously flow through the external circuit. • Identify the units of work (and energy), of power and of voltage and be able express an	3 3 3 3

			understanding of the meaning of such concepts.	
		14	• Solve simple computational problems which focus on the relationship between work (and energy), voltage, and charge.	3
		15	• Identify the definition of resistance, the units of resistance, and the factors effecting the amount of resistance in a circuit.	3
		16	• Solve simple computational problems which relate the voltage, resistance and current for a simple circuit(Ohm's Law)	3
		17	• Realize that the a current carrying wire deflects the compass and a dynamo (changing magnetic flux) produces electricity	3
HS-PS4-1.	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves	18	• Understand the basic relationships that rule all waves. They will be able to explain that a wave is a disturbance that transfers energy but not matter and explain the relationships between	

	traveling in various media.		amplitude, period, frequency, wavelength, and wave speed. They will then use this information to solve problems and labs.	
		19	• Apply fundamentals of waves to electromagnetic waves to know what is true of all electromagnetic waves and be able to compare and contrast what is different about each wave. In addition, they will research and report the affect each of these waves has in their lives.	
		20	• Explain, predict, compare and contrast the effects of the Doppler Affect, reflection, refraction, and diffraction on all types of waves.	
HS-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.	21	• Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.	
HS-PS4-3.	Evaluate the claims, evidence, and reasoning behind behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	22	• 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.	
		23	• Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons.	
		24	• The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other	

			features.	
HS-PS4-4.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	25 26	• When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). • Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.	
HS-PS5-5	Communicate technical information about about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy	27	• Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in	
Standard #	CCSS ELA Standard	SLO #	Student Learning Objectives	Depth of Knowledge
RST.11-12.1 RST11-12.2	• Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept;	28 29 30	• Utilize the textbook and suggested resources to support understanding • Use proper equipment to collect data • Review text materials on a teacher selected topic and present a summary	4 3 3

	provide an accurate summary of the text.			
RST11-12.3	• Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	31	• Use lab instructions and background materials to develop a scheme for collection and analysis of data	3
RST11-12.4	• Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 and 11-12 texts and topics.	32	• Define all key vocabulary terms and concepts and review them with the teacher	1
RST.11-12.7	• Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	33	• Make a simple sketch of the problem/lab with the important information presented	4
WHST.9-12.2	• Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	34	• Describe the objective of the lab activity and give a synopsis of the lab activity	4

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.	35 36	• Explain the expected outcomes of each step in an experimental procedure in one's own words making references to main concepts, equations and other relevant sources • Examine the data and compute the unknown desired quantity by using algebraic and graphical methods	4 4
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.	37	• Type a comprehensive coherent lab/project report that shows the objective, summary (with references made to concepts, articles etc.), data collection, sample calculations, and graphical representation.	4
WHST.9-12.9	• Draw evidence from informational texts to support analysis, reflection,	38	• Compare and argue the experimental results to the expected value and calculate the error	4

	and research.			

Big Ideas

- Charge is a fundamental property of matter
- There is an electric force between charged objects and like gravity it has an inverse square law behavior
- Moving charge is called a current and circuits are built based on the simple idea that current cannot be destroyed or created at the junctions
- Various tools are used to probe the potential difference and the current in an electric circuit
- Current produces magnetic field
- Changing magnetic flux produces electricity

Essential Questions

- What is current and what is its unit?
- Can one represent current in terms of fundamental units?
- Why do some materials allow electric flow?
- What are the purposes of batteries in and how do they provide it?
- How is the current generated related to the potential difference created across a circuit?
- How would one model the electric circuits using non-electric components?
- What are the advantages and disadvantages of parallel/series circuits? Explain both qualitatively and quantitatively.
- How is electricity and magnetism related? How does one produce the other?

Assessments

Through the group activities, problem solving sessions, unit tests/quizzes, and homework in the following areas:

- Has the student developed an understanding of wave properties?
- Has the student understood the concepts of electrical and magnetic fields
- Can the student understand and design simple circuits
- Does the student understand electrical power

Common Benchmark as per district schedule

Key Vocabulary

- Coulomb Law
- Electric Field
- Electric current
- Resistance
- Ohm's Law
- Electric Power
- Electric Circuits
- Biot-Savart Law
- Magnetic Induction

DIFFERENTIATION		
Special Education	**ELL**	**RtI**
• Modifications & accommodations as listed in the student's IEP • Assign a peer to help keep student on task • Modified or reduced assignments • Reduce length of assignment for different mode of delivery • Increase one to one time • Working contract between you and student at risk • Prioritize tasks • Think in concrete terms and provide hands on tasks • Position student near helping peer or have quick access to teacher • Anticipate where needs will be • Break tests down in smaller increments • NJDOE resources	• Strategy groups • Teacher conferences • Graphic organizers • Modification plan • NJDOE resources • Adapt a Strategy-Adjusting strategies for ESL students: http://www.teachersfirst.com/content/esl/adaptstrat.cfm	• Tiered Interventions following RtI framework • RtI Intervention Bank • Fundations Double-Dose (Tier II) • LLI (Tier III) • FFI Skill Report: DRA On-Line • enVision intervention supports • NJDOE resources

ALIGNMENT TO 21st CENTURY SKILLS AND TECHNOLOGY	
21st Century/ Interdisciplinary Themes: Bold all that apply	**21st Century Skills:** Bold all that apply
Global Awareness Financial, Economic, Business and Entrepreneurial Literacy Civic Literacy Health Literacy **Environmental Literacy**	**Creativity & Innovation** **Critical Thinking & Problem Solving** **Communication & Collaboration** **Media Literacy** **Information Literacy** **Information, Communication & Technology** **Life & Career Skills**

Technology Infusion

- Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others
- Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

Epson Interactive Whiteboard Applications

Evidence of Student Learning

• Common benchmark • Evaluation rubrics	• Teacher-student conferences • Running records	• Students' published work • Unit tests	• Quizzes • Laboratory Investigations