Physics 11

SAYREVILLE WAR MEMORIAL HIGH SCHOOL

6 CREDITS

Full Year

Date Curriculum Approved/ Revised: _____

Sayreville Public Schools Curriculum
Physics 11

Table of Contents

Summary of the Course: Physics 11 also known as and referred to as CP Physics is an introductory physics course designed to introduce students to various topics typically covered in a college physics course but taught in a high school lab format. The course is focused around a fundamental understanding of the principles of high school physics. Students will be exposed to and learn about motion, forces, energy, matter, waves and other physical phenomena typical found in the world. Success in this course requires students to have a mathematical foundation in algebra and geometry. All learning styles are addressed through instructional methods and assessments that incorporate scientific reading, writing, and computation. The basic format of the course is based on principles found through the New Jersey Center for Teaching and Learning.

In order to demonstrate a cohesive and complete implementation plan the following general suggestions are provided:

- The use of various formative assessments are encouraged in order to provide an ongoing method of determining the current level of understanding the students have of the material presented.
- Homework, when assigned should be relevant and reflective of the current teaching that is taking place in the classroom.
- Organizational strategies should be in place that allows the students the ability to take the information gained in the classroom and put in in terms that are relevant to them.
- Instruction should be differentiated to allow students the best opportunity to learn.
- Assessments should be varied and assess topics of instruction delivered in class.
- Modifications to the curriculum should be included that address students with Individualized Educational Plans (IEP), English Language Learners (ELL), and those requiring other modifications (504 plans).

Sayreville Public Schools Curriculum
Physics 11

As the teachers are working on the curriculum units in OnCourse, please remember that they should include the following as separate documents in the Curriculum Units folder:

- Title Page
- Table of Contents (List of the Units - does not need page numbers)
- Statement of Purpose
- Summary of Course

Unit 1: Kinematics

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **1st Marking Period**
Length: **25 days**
Status: **Published**

Unit 1: Kinematics

Summary of the Unit

This unit of study is devoted to both mathematical competency as well as knowledge of relationships among motion, vectors, velocity and acceleration. Solutions to algebraic equations as well as manipulations in Algebra 1 are important pre-requisite skills needed to be successful in physics. Additionally, students will be exposed to the topics of velocity and acceleration as they apply to motion. By the end of this unit, students will be able to solve quantitative problems specifically by first writing out all variables present, determining the appropriate equation to use, solving the equation for the variable needed, inserting numbers into the equation, and finally performing calculations with a scientific calculator, all invaluable skills necessary for success in this course.

Enduring Understandings

- The principles of kinematics can describe the motion of all objects
- An object's motion in one dimension can be expressed and analyzed using multiple representations.
- Motion is relative to its observer
- The acceleration of an object is directly related to its position and velocity, therefore, objects with a constant acceleration along a plane result in either a positive or negative slope when graphed on a velocity-time graph.

Essential Questions

- How are vectors used to analyze motion?
- What are the differences between speed and velocity and how are each applied to real life situations?
- What are the relationships between position, velocity, and acceleration?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
- American Association for the Advancement of Science: *http://www.aaas.org/programs*
- American Chemical Society: *http://www.acs.org/content/acs/en/education.html*
- Concord Consortium: Virtual Simulations: *http://concord.org/*
- International Technology and Engineering Educators Association: *http://www.iteaconnect.org/*
- National Earth Science Teachers Association: *http://www.nestanet.org/php/index.php*
- National Science Digital Library: *https://nsdl.oercommons.org/*
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: *http://www.naaee.net/*
- Phet: Interactive Simulations*https://phet.colorado.edu/*

Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Algebra Review	5 days	SWBAT manipulate and solve algebraic expressions SWBAT evaluate and solve radical expressions	Students will review and complete varied examples of algebraic equations, manipulation of algebraic equations, and evaluation of	Teacher created algebra review. Be sure to include review in algebraic manipulation,	MP.2 MP.4 HSA-CED.A.4

			radical expressions	solutions to radical expressions, and solutions to algebraic equations.	
Speed, Distance and Time	2 days	SWBAT solve for speed, distance, and time through manipulation of the speed equation, SWBAT calculate average speed, , and differentiate it from instantaneous speed,	Introduce speed equation: Guided and individual practice – problem solving Introduce average speed equation: Guided and individual practice – problem solving and utilization	Problem solving practice – class work and homework Average speed quiz	MP.2 MP.4 HSA-CED.A.4
Frames of Reference, Position, Displacement and Velocity	2 day	SWBAT describe motion in terms of frame of reference, displacement, time, and velocity. SWBAT calculate the displacement of an object traveling at a known velocity for a specific time interval. SWBAT differentiate between speed	Use practical examples of relative motion to teach frame of reference Guided and individual practice – calculating distance and displacement by drawing diagrams Speed vs. velocity discussion Guided and individual practice –	Problem solving practice – class work	MP.2 MP.4 HSA-CED.A.4

		and velocity , , and calculate each.	velocity calculations		
Quiz	1 day	TSW apply their knowledge of non-accelerated kinematics to complete a quiz.	Administer quiz	Quiz	MP.2 MP.4 HSA-CED.A.4
Motion with a constant acceleration	3 days	SWBAT describe motion with a changing velocity SWBAT apply and manipulate kinematic equation(s) to calculate distance, time, and/or velocity under conditions of constant acceleration	Describe and demonstrate accelerated motion Introduce equation: Guided and individual practice – problem solving Bowling Ball Lab	Problem solving – class work and homework Bowling Ball Lab data analysis (algebraic and graphical) and conclusion	MP.2 MP.4 HSA-CED.A.4
Free Fall	2 day	SWBAT relate the motion of a freely falling body to motion with constant acceleration SWBAT calculate velocity and	Demonstrate free fall Guided and individual practice – free fall calculations	Problem solving – class work and/or homework First Kinematics Equation Quiz	MP.2 MP.4 HSA-CED.A.4

		time of a free-falling object			
Second Kinematics Equation: Position vs. Time	3 days	SWBAT appropriately utilize the second kinematics equation, , to solve for associated quantities. SWBAT construct and interpret graphs of position vs. time	Introduce equation: Graph position vs. time Stomp Rocket Lab	Problem solving – second kinematics equation homework and/or classwork Stomp Rocket Lab Analysis and Conclusion Second Kinematics Equation Quiz	MP.2 MP.4 HSA-CED.A.4
Third Kinematics Equation	4 days	SWBAT appropriately utilize the third kinematics equation, , to solve for associated variables SWBAT compare and construct graphical representations of accelerated motion and non-accelerated motions	Introduce equation: Problem solving – guided and individual/small group practice Graphing Practice Hopper Lab	Problem Solving – Third Kinematics Equation homework and/or classwork Graphing classwork Hopper Lab analysis and conclusion Third Kinematics Law Quiz	MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of kinematics to	Review Concepts and problems formally and	Practical Problem Solving	MP.2 MP.4

		complete a review and then a subsequent formal assessment	with games Administer Assessment	review Kinematics Assessment	HSA-CED.A.4

9-12.HS-PS2-2.5.1 Use mathematical representations of phenomena to describe explanations.

Suggested Modifications for Special Education, ELL and Gifted Students

*Consistent with individual plans, when appropriate.

Students with individual learning styles can be assisted through adjustments in assessment standards and time restraints, one-to-one teacher support, extended testing time, and use of visual and auditory teaching methods. This wide variety of assessments, strategies, and hands-on evaluations complement the individual learning experience. Additional strategies are as follows:

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- 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 students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- 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.
- Provide English Language Learners students with multiple literacy strategies.

Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

-Education focused websites, like Edmodo and Google Platform, to provide group forums to

discuss topics

-Online programs, such as Quia and Kahoot, to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy.

9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

English Language Arts/Literacy

- 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.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- Draw evidence from informational texts to support analysis, reflection, and research.
- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.

- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 2: Dynamics

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **1st Marking Period**
Length: **22 Days**
Status: **Published**

Summary of the Unit

This unit introduces students to the concept of inertia used to determine the motion of an object experiencing a net force and a zero net force. Additionally, Newton's Laws of Motion will be introduced and reviewed in order to develop the concept of motion and reaction. Students will be exposed to and expected to draw and interpret free-body diagrams, solve relevant equations and use these results to solve relevant problems. The concept of friction will also be introduced and students will be expected to not only find the friction force but apply this concept to real life situations. Students will learn how to identify the following forces and illustrate their relative magnitude and directions: Applied Force, Normal Force, Weight (Gravitational Force), Apparent Weight, Tension, and Friction (Kinetic and Static).

Enduring Understandings

- Forces are detected by their influence on the motion of an object.
- A force exerted on an object is always due to the interaction of that object with another object.
- If one object exerts a force on a second object, the second object always exerts a force of equal magnitude on the first object in a different direction.
- The acceleration of an object, but not necessarily its velocity, is always in the direction of the net force exerted on an object by other objects.
- If an object interacts with several other objects, the net force is the vector sum of the individual forces.

Essential Questions

- How can an object be made to accelerate?
- How do forces interact?
- How do objects respond to multiple forces acting on them?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly

exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
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- Phet: Interactive Simulations*https://phet.colorado.edu/*

Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Dynamics and Newton's First Law	2 days	SWBAT describe what a force is, how it is measured, and how a force affects the motion of an object	Newton's First Law Demonstration Guided and individual/small group practice – predicting motion using Newton's First Law	Problem solving – predicting motion	HS-PS2 MP.2 MP.4 HSA-CED.A.4
Newton's	2 days	SWBAT	Newton's	Problem	HS-PS2-1

Second Law		describe an object's acceleration in terms of its mass and the net force acting on it SWBAT predict the direction and magnitude of the acceleration caused by a known net force	Second Law Demonstration Guided and individual/group practice – Newton's Second Law problems Quiz review Administer Quiz	solving – Newton's second law classwork and homework Newton's Second Law Quiz	MP.2 MP.4 HSA.CED.A.4
Mass, Weight & Newton's Third Law	3 days	SWBAT explain the difference between mass and weight SWBAT find the direction and magnitude of the normal force SWBAT identify action-reaction forces (Newton's Third Law)	Compare mass and weight Newton's Third Law Demonstration Guided and individual/small group practice – normal force Guided and individual/small group practice – Newton's Third Law problem solving	Class work/ homework – Problem Solving: normal force, Newton's Third Law Quiz	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4
Free Body Diagrams	1 day	SWBAT interpret and construct free body diagrams	Veritasium Video Guided and individual/small group practice – free body diagrams	Problem solving homework – free body diagrams	HS-PS2
Inertia Lab	2 days	SWBAT	Inertia Lab	Inertia Lab	HS-PS2-2

		measure the acceleration due to gravity SWBAT verify Newton's second law empirically		analysis and conclusion	MP.2 MP.4 HSA-CED.A.4
Kinetic and Static Friction	2 days	SWBAT identify sources of friction and classify them SWBAT differentiate static and kinetic friction SWBAT describe air resistance as a form of friction SWBAT use the coefficient of friction to calculate frictional force and compare forces due to friction	Friction Demonstration Guided and individual/small group practice – classifying friction Guided and individual/small group practice – coefficient of friction problems	Homework and classwork – friction problem solving	HS-PS-2-1 MP.2 MP.4 HSA-CED.A.4
Tension & Apparent Weight	2 days	SWBAT use free body diagrams to solve for the tension force and apparent weight	Explain tension using practical examples Free body diagrams to calculate tension and apparent weight – guided then individual/ small group	Classwork/ homework – calculating tension and apparent weight using free body diagrams Friction Quiz	HS-PS2-1 HS-PS2-2 MP.2 MP.4 HSA-CED.A.4

			practice Friction review		
Friction Lab and Review Problems	3 days	TSW use a graphical approach to find the coefficient of friction	Friction Lab Review problems – small group practice	Friction Lab Analysis and Conclusion Friction Lab Quiz Review Problems	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4
Hooke's Law Lab	2 days	TSW establish Hooke's Law and find the value of the spring constant for multiple springs	Hooke's Law Discovery Lab	Hooke's Law Lab Analysis and Conclusion Hooke's Law Quiz	MP.2 MP.4 HSA-CED.A.4
Review and Assess	3 days	TSW apply their knowledge of Dynamics to complete a review and formal assessment	Review – individual and small/group practice Review game Assessment	Problem solving – review classwork and homework Dynamics Assessment	HS-PS2-1 HS-PS2-2 MP.2 MP.4 HSA-CED.A.4

Suggested Modifications for Special Education, ELL and Gifted Students

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Students with individual learning styles can be assisted through adjustments in assessment standards and time restraints, one-to-one teacher support, extended testing time, and use of visual and auditory teaching methods. This wide variety of assessments, strategies, and hands-on evaluations complement the individual learning experience. Additional strategies are as follows:

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- Provide English Language Learners students with multiple literacy strategies.

Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

-Education focused websites, like Edmodo and Google Platform, to provide group forums to discuss topics

-Online programs, such as Quia and Kahoot, to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

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English Language Arts/Literacy

- 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.
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- Draw evidence from informational texts to support analysis, reflection, and research.
- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 3: Universal Circular Motion

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **2nd Marking Period**
Length: **14 Days**
Status: **Published**

Summary of the Unit

Summary of the Unit: This Unit involves the study of circular objects and their relationship to the physical world. Students will relate the radius of a circle and the speed or rate of revolution of a particle to the magnitude of the centripetal acceleration. Students will also learn how to describe the direction of a particle's velocity and acceleration at any instant during circular motion. Additionally, situations will be analyzed whereby an object moves with a specified acceleration under the influence of forces such that the magnitude and direction of successive forces that makes up the net force can be determined. Topics to address include motion in a horizontal circle (a merry go round) as well as vertical motion (swinging an object on a string).

Enduring Understandings

Enduring Understanding:

- The radius of a circular object and speed or rate of revolution of a particle relate to the magnitude of the centripetal acceleration.
- Situations exist whereby acceleration under the influence of one or more forces determine the magnitude and direction of the net force.

Essential Questions

Essential Questions:

- How are Free Body diagrams and Newton's Laws used to solve circular motion problems?
- What are the applications of circular motion?
- How does apparent weight vary during circular motion?

Summative Assessment and/or Summative Criteria

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.

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exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Resources:

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
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Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Period and Frequency	2 days	SWBAT calculate the period and frequency of circular motion SWBAT describe the relationship between period and frequency	Problem solving – guided and individual/small group practice - period and frequency	Class work/ homework – problem solving – period and frequency	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

Velocity and Acceleration	4 days	SWBAT explain how the kinematics of circular motion differs from linear motion SWBAT calculate centripetal acceleration	Discussion Guided then individual/small group practice – centripetal acceleration problem solving	Class work and homework – problem solving – centripetal acceleration	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4
Dynamics of Circular Motion	2 days	SWBAT explain how the apparent existence of an outward force in circular motion can be explained as inertia resisting the centripetal force SWBAT calculate centripetal force	Demonstration – bucket on string Centripetal force calculations – guided then individual/small group practice	Class work and homework – problem solving – centripetal force	HS-PS-2-1 MP.2 MP.4 HSA-CED.A.4
Free Response Problems	3 days	SWBAT apply their knowledge of circular motion to solve practical physical problems	Bucket on a string problems – small group and individual practice Free Response problems – small group and individual practice	Classwork and homework – free response problems	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4
Review and Assess	3 days	TSW apply their knowledge of circular motion to review/assessment	Review for Assessment – small group and individual practice	Review – class work and homework Assessment	HS-PS2-1 HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

Suggested Modifications for Special Education, ELL and Gifted Students

Suggested Modifications for Special Education, English Language Learners and Gifted Students:

*Consistent with individual plans, when appropriate.

Students with individual learning styles can be assisted through adjustments in assessment standards and time restraints, one-to-one teacher support, extended testing time, and use of visual and auditory teaching methods. This wide variety of assessments, strategies, and hands-on evaluations complement the individual learning experience. Additional strategies are as follows:

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- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- 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.
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Suggested Technological Innovations/Use

Suggested Technological Innovations/ Use:

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Cross Curricular/ 21st Century Connections:

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9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

English Language Arts/Literacy

- 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.
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Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales

- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 4: Universal Gravitation

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **2nd Marking Period**
Length: **11 Days**
Status: **Published**

Summary of the Unit

This Unit discusses Newton's Law of Universal Gravitation. Objects in orbit will be discussed as well as properties of these objects. Students will calculate and find forces that symmetrical masses exert on each other. The strength and makeup of gravitational fields will be introduced along with a determination of the relative strength of these fields. Students will calculate and describe how the velocity, period of revolution and centripetal acceleration depend on the radius of the orbit.

Enduring Understandings

- A field associates a value of some physical quantity with every point in space.
- A gravitational field is caused by an object with mass.
- The gravitational field caused by a spherically symmetric object with mass is radial and, outside the object, varies as the inverse square of the radial distance from the center of that object.

Essential Questions

- How are mass, separation and gravitational force related?
- How does the mass of a planet relate to its gravitational force?
- How can apparent weightlessness of orbiting objects be explained?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

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Unit Plan with Associated Standards Chart

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**New Jersey Student Learning Standards**
Review of Scientific Notation and Computations	3 days	SWBAT convert numbers to an from scientific notation and complete calculations with scientific notation	Review of notation in addition to relevant computations involving scientific notation.	Class work/ homework – scientific notation practice	MP.2 MP.4 HSA-CED.A.4
Gravitational Force	1 day	SWBAT determine the force that one spherically symmetrical mass exerts on another.	Baseball activity/lab Presentation – guided/individual practice of gravitational force problems	Classwork/ homework – gravitational force problems Baseball lab analysis	HS-PS2-4 MP.2 MP.4 HSA-CED.A.4
Gravitational Fields	2 days	SWBAT determine the strength of the gravitational field	Baseball activity/lab, continued.	Classwork/ homework – gravitational field	HS-PS2-4 MP.2

		at a specified point outside a spherically symmetrical mass.	Presentation – guided/individual practice of gravitational field problems	problems Baseball lab analysis	MP.4 HSA-CED.A.4
Orbital Motion	2 days	SWBAT recognize that the motion does not depend on the object's mass SWBAT Describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend upon the radius of the orbit SWBAT Derive expressions for the velocity and period of revolution in such an orbit.	Orbital Motion Demonstration Presentation – guided/individual practice of Orbital Motion problems	Demonstration discussion/analysis Classwork/ homework – Orbital Motion problems	HS-PS2-1 HS-PS2-4 MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of Universal Gravitation to review/assessment	Review for Assessment – small group and individual practice Assessment	Review – class work and homework Assessment	HS-PS2-1 HS-PS2-4 MP.2 MP.4 HSA-CED.A.4

Suggested Modifications for Special Education, ELL and Gifted Students

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evaluations complement the individual learning experience. Additional strategies are as follows:

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- 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 students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- 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.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

-Education focused websites, like Edmodo and Google Platform, to provide group forums to discuss topics

-Online programs, such as Quia and Kahoot, to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy.

9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

English Language Arts/Literacy

- 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.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- Draw evidence from informational texts to support analysis, reflection, and research.
- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 5: Energy

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **2nd Marking Period**
Length: **13 Days**
Status: **Published**

Summary of the Unit

This Unit will explain the very broad concept of Energy. Students will be exposed to and use in real life situations the concept of work, the work-energy theorem, potential and kinetic energy, mechanical energy in addition to the Conservation of Energy in a system. Students will calculate kinetic and potential energy and be able to relate these changes. They will also be able to relate to work done by a force to the area under a graph of force as a function of position. The change in mechanical energy to other forms of energy and the relationship to work in addition to changes based on friction will be introduced as well. Conservation of Energy in the analysis of the motion of objects as it relates to Newton's Laws would be a central theme of this unit.

Enduring Understandings

- A force exerted on an object can change the kinetic energy of the object.
- Interactions with other objects or systems can change the total energy of a system.
- Certain quantities care conserved, in the sense that the changes in there quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems.
- The energy of a system is conserved.

Essential Questions

- How do we determine the work done on a physical system when the net force acting on it and its displacement are known?
- How do we use the work/ energy theorem to determine the motion of an object?
- How do we apply energy conservation to determine the position and motion of an object?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
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- Phet: Interactive Simulations*https://phet.colorado.edu/*
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Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Conservation of Energy & Gravitational Potential Energy	2-3 days	SWBAT state and apply the relation between the work performed on an object by non-conservative forces and the change in an object's mechanical	Rollercoaster demonstration or activity Presentation – guided and individual practice (Conservation problems and potential energy problems) Diagramming	Rollercoaster activity analysis Classwork/ homework problems Energy transfer diagrams	HS-PS2-1 HS-PS3-1 MP.2 MP.4 HSA-CED.A.4

		energy. SWBAT describe and identify situations in which mechanical energy is converted to other forms of energy. SWBAT identify situations in which mechanical energy is or is not conserved. SWBAT apply conservation of energy in analyzing the motion of systems of connected objects, such as an Atwood's machine. SWBAT apply conservation of energy in analyzing the motion of objects that move under the influence of springs.	energy transfer		

		SWBAT recognize and solve problems that call for application both of conservation of energy and Newton's Laws.			
Kinetic and Elastic Potential Energy	2 days	SWBAT calculate the change in kinetic energy or speed that results from performing a specified amount of work on an object. SWBAT analyze situations in which an object's mechanical energy is changed by friction or by a specified externally applied force. SWBAT calculate the work performed by the net force, or by	Rube Goldberg Demonstration or activity Include Mixed problems from previous units Presentation and introduction of mathematical equations Guided and individual practice – kinetic and elastic potential energy problems	Rube Goldberg activity analysis Classwork/ homework – energy problems	HS-PS2-1 HS-PS3-1 HS-PS3-2 HS-PS3-3 MP.2 MP.4 HSA-CED.A.4

		each of the forces that make up the net force, on an object that undergoes a specified change in speed or kinetic energy. SWBAT apply the theorem to determine the change in an object's kinetic energy and speed, which results from the application of specified forces, or to determine the force that is required in order to bring an object to rest in a specified distance. SWBAT write an expression for the force exerted by an ideal spring and			

		for the potential energy of a stretched or compressed spring.			
Energy Assessment	1 day	TSW apply their knowledge of energy to complete a practical problem-based assessment	Assessment	Assessment	HS-PS2-1 HS-PS3-1 HS-PS3-2 HS-PS3-3 MP.2 MP.4 HSA-CED.A.4
Marble Launcher Lab	1 – 2 days	TWS apply the conservation of energy and observe the relationship among kinetic energy, gravitational potential energy, and elastic potential energy	Marble launcher presentation Marble Launcher activity	Marble Launcher lab data analysis and error analysis	HS-PS2-1 HS-PS3-1 HS-PS3-2 HS-PS-3-3 MP.2 MP.4 HSA-CED.A.4
Power and General Problems	3 days	SWBAT calculate the power required to maintain the motion of an object with constant acceleration (e.g., to move an	Power demonstration Presentation and introduction of mathematical equations to solve power problems	Demonstration discussion/analysis Classwork/ homework – Power problems	HS-PS2-1 HS-PS3-1 HS-PS3-2 HS-PS3-3 MP.2 MP.4

		object along a level surface, to raise an object at a constant rate, or to overcome friction for an object that is moving at a constant speed). SWBAT calculate the work performed by a force that supplies constant power, or the average power supplied by a force that performs a specified amount of work.	Guided and individual practice – power problems Guided and individual practice – mixed problems		HSA-CED.A.4
Review and Assessment	2 – 3 days	TSW apply their knowledge of Energy to complete a review and assessment	Practical problem-based review Practical problem-based assessment	Review Homework/ Classwork Assessment	HS-PS2-1 HS-PS3-1 HS-PS3-2 HS-PS3-3 MP.2 MP.4 HSA-CED.A.4

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- 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.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

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Unit 6: Momentum

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **2nd Marking Period**
Length: **15 Days**
Status: **Published**

Summary of the Unit

The central idea of this unit is that a force exerted on an object can change the momentum of the object. The change in momentum of an object is a vector in the direction of the net force exerted on the object. Students will be able to discuss the relationship between certain physics quantities related to impulse and momentum in addition to exploring the fundamental law of physics- Conservation of Momentum.

Enduring Understandings

- A force exerted on an object can change the momentum of the object.
- The change in momentum of an object occurs over a time interval.

Essential Questions

- How do we determine the impulse on a physical system when the forces on the system and the time interval these forces are are known?
- What are the differences between elastic and inelastic collisions?

Summative Assessment and/or Summative Criteria

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Unit Plan with Associated Standards Chart

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**New Jersey Student Learning Standards**
Momentum and Impulse	2 days	SWBAT compare the momentum of different moving objects SWBAT compare the momentum of the same object moving with different velocities SWBAT identify and describe changes of momentum of an object in terms of force and time	Demonstration/ Activity – tennis and basketball Presentation – momentum and impulse Guided/Individual practice – momentum and impulse	Tennis and Basketball Activity analysis questions Classwork/ homework – momentum and impulse	HS-PS2-2 MP.2 MP.4 HSA-CED.A.4

Momentum of a System of Objects and Conservation of Momentum	2 days	SWBAT describe the interaction between two objects in terms of momentum of each SWBAT compare the total momentum before and after they interact SWBAT predict the final momentum of an object	Demonstration/ Activity – Newton's Cradle Presentation – conservation of momentum Guided/individual practice – conservation of momentum problems	Newton's Cradle Activity analysis Homework/ classwork – conservation of momentum problems	HS-PS2-2 MP.2 MP.4 HSA-CED.A.4
Inelastic Collisions and Explosions	2 days	SWBAT identify different types of collisions SWBAT differentiate inelastic collisions and explosions SWBAT determine the changes in kinetic energy during perfectly inelastic collisions	Demonstration/ video – types of collisions Presentation – inelastic collisions and explosions Guided/individual practice – inelastic collisions and explosions	Discussion – types of collisions video/ demonstration Homework/ classwork – inelastic collisions and explosions problems	HS-PS2-2 MP.2 MP.4 HSA-CED.A.4
Elastic Collisions	4 days	SWBAT compare	Demonstration – crash cart	Discussion/analysis – crash cart	HS-PS2-2

		conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions SWBAT find the final velocity of an object in collisions TSW observe elastic and inelastic collisions and demonstrate that momentum is conserved	collisions Presentation – elastic collisions Guided/ individual practice – collisions Momentum Lab	collisions Homework/ classwork – elastic collisions Momentum lab – data analysis and error analysis	HS-PS2-3 MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of momentum to complete a momentum review and assessment	Review – practice algebraic problems, practical application problems Assessment	Classwork/ homework – review Assessment	HS-PS2-2 HS-PS2-3 MP.2 MP.4 HSA-CED.A.4

Suggested Modifications for Special Education, ELL and Gifted Students

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Unit 7: Fluids

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **3rd Marking Period**
Length: **13 Days**
Status: **Published**

Summary of the Unit

The central idea of this unit is that fluids, due to their molecular structure, behave differently than solids. Fluids are able to be used to transfer energy and do work. At the end of this unit, students will know density, specific gravity, fluid pressure, atmospheric pressure, Pascal's Principle, Buoyancy, Archimedes' Principle, Bernoulli's Principle, and hydraulics. Students will be able to utilize numerous algebraic expressions to solve for fluid pressure and buoyant force.

Enduring Understandings

- Forces have magnitude and direction. Forces vectors can be added. The net force on an object is the sum of all the forces acting on the object.
- An object at rest will remain at rest unless acted on by an unbalanced force; an object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force.
- Mass is a direct measurement of inertia, resistance to acceleration.
- The motion of an object changes only when a net force is applied.
- During interactions every action force is countered by an equal and opposite reaction force.
- The magnitude of acceleration of an object depends directly on the strength of the net force, and inversely on the mass of the object. This relationship (a=Fnet/m) is independent of the nature of the force.
- Friction and fluid drag forces tend to slow or prevent the motion of objects.

Essential Questions

- How is density defined?
- What is the difference between gauge pressure and absolute pressure?
- How do hydraulic lifts work?
- What is the buoyant force?
- How do water speeds vary in pipes?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

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Unit Plan with Associate Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Density, Specific Gravity, and Pressure	2 days	SWBAT describe, differentiate, utilize, and calculate density, specific gravity, and pressure	Density column demonstration Presentation – density, specific gravity, and pressure Guided/individual practice – density, specific gravity, and pressure	Density column demonstration analysis/discussion Classwork/ homework – density, specific gravity, and pressure	MP.2 MP.4 HSA-CED.A.4

Pascal's Principle	1-2 days	SWBAT describe how pressure is transmitted in a fluid according to Pascal's Principle SWBAT explain how a hydraulic system works to change a force SWBAT explain how the speed and pressure of a fluid are related according to Pascal's Principle	Hydraulic system demonstration/ activity Presentation – Pascal's principle and hydraulics Guided/individual practice – Pascal's principle and hydraulics	Hydraulic system activity – analysis/ discussion Classwork/ homework – Pascal's Principle and hydraulics	MP.2 MP.4 HSA-CED.A.4
Buoyancy and Archimedes' Principle	3 days	SWBAT determine the buoyant force of an object and determine if it will sink or float SWBAT explain the effect of buoyancy on the apparent weight of an object SWBAT explain the relationship between the	Buoyancy demonstration Presentation – buoyancy and Archimedes' Principle Guided/individual practice – buoyant forces and Archimedes' Principle Penny Buoyancy Lab	Classwork/ homework – buoyancy and Archimedes' Principle Classwork/ homework – buoyant forces and Archimedes' principle Penny Buoyancy Lab analysis	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4

		volume of fluid displaced by an object and buoyant force acting on an object according to Archimedes Principle			
Fluid Dynamics	1 day	SWBAT examine the motion of a fluid using the continuity equation SWBAT recognize the effects of Bernoulli's Principle on fluid motion	Aerodynamics demonstration Presentation – fluid dynamics and Bernoulli's Principle Guided/ individual practice – continuity equation and Bernoulli's principle	Aerodynamics demonstration analysis Classwork/ homework – continuity equation, Bernoulli's principle	MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of fluids to complete a unit review and assessment	Review consisting of conceptual and practical algebraic problems Assessment	Review consisting of conceptual and practical algebraic problems Assessment	HS-PS2-1 MP.2 MP.4 HSA-CED.A.4

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- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- 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.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

-Education focused websites, like Edmodo and Google Platform, to provide group forums to discuss topics

-Online programs, such as Quia and Kahoot, to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy.

9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

English Language Arts/Literacy

- 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.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- Draw evidence from informational texts to support analysis, reflection, and research.
- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 8: Simple Harmonic Motion

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **3rd Marking Period**
Length: **12 Days**
Status: **Published**

Summary of the Unit

Restoring forces can result in oscillatory motion. When a linear restoring force is exerted on an object displaced from an equilibrium position, the object will undergo a special type of motion called simple harmonic motion. This unit re-visits the concepts of potential and kinetic energy and applies those concepts to simple harmonic motion. Students will explore springs and pendulums and how potential and kinetic energy are related in those particular systems.

Enduring Understandings

- Restoring forces can result in oscillatory motion.
- Restoring force proportional to displacement from equlibrium.

Essential Questions

- What is simple harmonic motion?
- How do we determine the energy, position, speed, acceleration, frequency and period of a physical system?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*

- American Association for the Advancement of Science: *http://www.aaas.org/programs*
- American Chemical Society: *http://www.acs.org/content/acs/en/education.html*
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- National Earth Science Teachers Association: *http://www.nestanet.org/php/index.php*
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- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: *http://www.naaee.net/*
- Phet: Interactive Simulations*https://phet.colorado.edu/*
- Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**New Jersey Student Learning Standards**
Simple Harmonic Motion	3 days	SWBAT identify the conditions of simple harmonic motion SWBAT differentiate simple harmonic motion and unsteady harmonic motion SWBAT explain how force, velocity and acceleration change as an object vibrates with simple	Simple Pendulum demonstration/ activity Presentation – simple harmonic motion Guided/individual practice – simple harmonic motion	Simple Pendulum activity analysis Classwork/ homework – simple harmonic motion	HS-PS2-1 HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		harmonic motion			
Measuring Harmonic Motion	4 days	SWBAT identify the amplitude of vibration SWBAT recognize the relationship between period and frequency SWBAT calculate the period and frequency of an object vibrating with simple harmonic motion	Mass Spring Pendulum Demonstration Presentation – measuring harmonic motion Guided/individual practice – measuring harmonic motion Spring Pendulum Discovery Lab	Mass Spring Pendulum Demonstration analysis/discussion Classwork/ homework – measuring harmonic motion Spring Pendulum Discovery Lab Analysis	HS-PS2-1 HS-PS4-1 MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of simple harmonics to complete a practical review and assessment	Guided/ individual practice and review Assessment	Practical review Assessment	HS-PS2-1 HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

9-12.HS-PS2	Motion and Stability: Forces and Interactions
9-12.HS-PS4	Waves and Their Applications in Technologies for Information Transfer

Suggested Modifications for Special Education, ELL and Gifted Students

*Consistent with individual plans, when appropriate.

Students with individual learning styles can be assisted through adjustments in assessment standards and time restraints, one-to-one teacher support, extended testing time, and use of visual and auditory teaching methods. This wide variety of assessments, strategies, and hands-on

evaluations complement the individual learning experience. Additional strategies are as follows:

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- 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).
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- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
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- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
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Suggested Technological Innovations/Use

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English Language Arts/Literacy

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- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
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- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 9: Sound and Waves

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **3rd Marking Period**
Length: **14 Days**
Status: **Published**

Summary of the Unit

A wave is a traveling disturbance that transfers energy and momentum. Waves can propagate via different oscillation modes that transfer energy and momentum. In general, waves can be transverse or longitudinal. The amplitude of a wave is the maximum displacement from its equilibrium value. For a periodic wave, the period is the repeat time of the wave, the frequency is the number of repetitions of the wave per unit time. In this unit, students will explore both transverse and longitudinal waves and make conclusions about what happens when waves interact. They will also explore the concept of sound and how it is related to waves.

Enduring Understandings

- Waves can transfer energy and momentum from one location to another without permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- A periodic wave is one that repeats as a function of both tie and position and can be described by its amplitude, frequency, wavelength, speed and energy.
- When two waves cross, they travel through each other rather than bounce off each other.
- Waves can propagate via different oscillation modes such as transverse and longitudinal.
- Classically, the energy carried by a wave depends upon and increases with amplitude.
- Standing waves are the result of the addition of incident and reflected waves that are confined to a region.

Essential Questions

- What are the properties of waves?
- How do we distinguish the difference between longitudinal and transvers waves?
- What happens when two waves overlap?
- How do we define the nature of sound waves?
- How do different musical instruments such as open and closed tubes create sound?
- What happens when two sound waves interact?
- What happens when either the source of a sound or the observer moves?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
- American Association for the Advancement of Science: *http://www.aaas.org/programs*
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- National Science Digital Library: *https://nsdl.oercommons.org/*
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- North American Association for Environmental Education: *http://www.naaee.net/*
- Phet: Interactive Simulations*https://phet.colorado.edu/*
- Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Properties of Waves	2 days	SWBAT distinguish local particle movement from overall wave motion SWBAT interpret waveforms of transverse and	Wave demonstration Presentation – wave properties Guided/individual practice – calculating speed, frequency, and wavelength	Wave demonstration analysis Classwork/ homework - Calculations	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		longitudinal waves SWBAT apply the relationship among wave speed, frequency, and wavelength to solve problems			
Wave Interactions	3 days	SWBAT apply the superposition principle SWBAT differentiate between constructive and destructive interference SWBAT predict when a reflected wave will be inverted SWBAT predict whether specific traveling waves will produce a standing wave SWBAT identify nodes and antinodes of a standing	Wave simulations Presentation – wave interactions Guided/individual practice – interference calculations Guided/individual practice – standing wave predictions Standing Waves Lab	Classwork/ homework – calculations and predictions Standing Waves Lab Analysis Wave quiz	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		wave			
Sound Waves	1 day	SWBAT explain how sound waves are produced SWBAT relate frequency to pitch SWBAT compare the speed of sound in various media SWBAT recognize the Doppler Effect and determine the direction of a frequency shift when there is relative motion between a source and observer	Doppler Effect demonstration Presentation – Sound Waves Guided/individual practice – sound waves and Doppler Effect conceptual problems	Doppler Effect Demonstration analysis Classwork/ homework – Sound Waves and Doppler Effect conceptual problems	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4
Sound Intensity and Resonance	1 day	SWBAT Calculate the intensity of Sound waves SWBAT relate intensity, decibel level, and perceived loudness SWBAT explain why	Tuning Fork Demonstration Presentation – sound intensity and resonance Guided/ individual practice – intensity and resonance conceptual problems	Tuning Fork Demonstration Analysis Classwork/ homework – Sound Intensity and Resonance Conceptual problems	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		resonance occurs			
Harmonics	2 days	SWBAT differentiate between the harmonic series of open and closed pipes SWBAT calculate the harmonics of a vibrating string and of open and closed pipes SWBAT relate the frequency difference between two waves to the number of beats heard per second	Harmonics/ Instrument Demonstration or Activity Presentation – Harmonics Guided/ individual practice – open and closed pipe problems	Harmonics/ Instrument Demonstration or Activity analysis Classwork/ homework – open and closed pipe problems	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of Waves and Sound to complete a conceptual and algebraic practical review and assessment	Guided/ individual practice – conceptual and algebraic problems Assessment	Classwork/ homework – review Assessment	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

Suggested Modifications for Special Education, ELL and Gifted Students

*Consistent with individual plans, when appropriate.

Students with individual learning styles can be assisted through adjustments in assessment

standards and time restraints, one-to-one teacher support, extended testing time, and use of visual and auditory teaching methods. This wide variety of assessments, strategies, and hands-on evaluations complement the individual learning experience. Additional strategies are as follows:

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
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- Provide English Language Learners students with multiple literacy strategies.
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Suggested Technological Innovations/Use

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-Education focused websites, like Edmodo and Google Platform, to provide group forums to discuss topics

-Online programs, such as Quia and Kahoot, to assess and/or poll students before, during, and after unit lesson

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English Language Arts/Literacy

- 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.
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- 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.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
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- Define appropriate quantities for the purpose of descriptive modeling.
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- Interpret expressions that represent a quantity in terms of its context.
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Unit 10: Electromagnetic Waves

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **4th Marking Period**
Length: **10 Days**
Status: **Published**

Summary of the Unit

This unit is a continuation of the previous unit on waves, but allows students to explore electromagnetic waves such as light. Electromagnetic waves can transmit energy through a medium and through a vacuum. In general they are transverse waves composed of mutually perpendicular electric and magnetic fields. Students will explore, predict and defend observations and conclusions based on how light behaves as a wave. Explorations into the electromagnetic spectrum will also take place in addition to the relationships between wave speed and frequency.

Enduring Understandings

- Waves can propagate via different oscillation modes such as transverse and longitudinal.
- When waves pass through an opening whose dimensions are comparable to the wavelength, a diffraction pattern can be observed.
- Types of electromagnetic radiation are characterized by their wavelengths.
- Electromagnetic waves can transmit energy through a medium and through a vacuum.

Essential Questions

- How does light behave like a wave?
- How do we identify the electromagnetic spectrum?
- How does wave rate speed relate to frequency?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

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- Phet: Interactive Simulations*https://phet.colorado.edu/*
- Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**New Jersey Student Learning Standards**
Characteristic of Light	1-2 days	SWBAT describe the characteristics of electromagnetic waves in a vacuum and how Michelson measured the speed of light SWBAT calculate the wavelength and frequency of electromagnetic radiation and describe their relationship SWBAT	Presentation – EM Radiation Guided/individual practice – wavelength and frequency Luminous Flux demonstration	Classwork/ homework – wavelength and frequency of EM radiation Luminous Flux demonstration analysis	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		describe the evidence for the dual nature of EM radiation SWBAT describe how the brightness of a light source is affected by distance			
Behavior of Light	4 days	SWBAT classify materials as transparent, translucent, or opaque to visible light SWBAT describe what happens when light it reflected, refracted, polarized, or diffracted SWBAT solve various problems relating to light in double slit experiments and thin films using appropriate equations	Demonstration – materials and light Presentation – behavior of light Demonstration – reflection, refraction, and diffraction Guided/individual practice – behavior of light conceptual problems and double slit experiment and thin film algebraic problems Diffraction Grating Lab	Materials and light demonstration analysis Reflection, refraction, and diffraction demonstration analysis Classwork/ homework – behavior of light conceptual problems and double slit experiment and thin films mathematical problems Diffraction Grating Lab Analysis	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4
Review and Assessment	3 days	TSW apply their knowledge of electromagnetic radiation to complete a review and assessment	Review – guided and individual practice Assessment	Classwork/ homework – review Assessment	HS-PS4-1 MP.2 MP.4 HSA-CED.A.4

		comprising of both conceptual and mathematical problems			

Suggested Modifications for Special Education, ELL and Gifted Students

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- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- 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.
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Suggested Technological Innovations/Use

-Internet for up-to-date resources such as journal articles and simulations (YouTube)

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English Language Arts/Literacy

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Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
- Define appropriate quantities for the purpose of descriptive modeling.
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quantities.

- Interpret expressions that represent a quantity in terms of its context.
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- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit 11: Electricity and Circuits

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **4th Marking Period**
Length: **17 Days**
Status: **Published**

Summary of the Unit

This unit involves a study of electricity, electric charge and electrical forces. Students will be exposed to the different types of charges involved in electricity. Students will make predictions about charges and explore the different types of interactions that occur. Coulomb's Law will be explored and the properties of this law will be used to solve real life problems. Students will be asked to make predictions about the charges involved in electricity. Electric charge is conserved. The net charge of a system is equal to the sum of the charges of all the objects in the system. This unit also asks students to explore electricity, charges and currents. Relationships between voltage, current and resistance will be explored as well as exploration into Ohm's Law. Kirchhoff's loop rule will be introduced whereby the conservation of energy in electrical circuits will be introduced. This is a common theme from earlier units.

Enduring Understandings

- Electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge.
- Electric charge is conserved.
- There are only two types of electric charge.
- Electric charge is conserved.
- The resistance of a resistor and the capacitance of a capacitor can be understood from the basic properties of electric fields and forces.
- The values of currents and electric potential differences in an electric circuit are determined by the properties and arrangements of the individual circuit elements.

Essential Questions

- What are the names of and types of electric charges that exist?
- Which particle of an atom carries a positive charge? Which carries the negative charge?
- What causes the sparks that emanate from removing a sweater in a dark room?
- What are voltage, current and resistance?
- How are voltage, current and resistance related?
- What factors affect resistivity?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Resources:

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Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Electric Charge and Static Electricity	2 days	SWBAT analyze factors that affect strength and direction of	Demonstration – Introduction to Electrostatic Forces Demonstration – Wimshurst	Demonstration – Introduction to Electrostatic Forces analysis Demonstration	HS-PS2-4 HS-PS3-1 HS-PS3-2 HS-PS3-5

		electric forces and fields SWBAT describe how electric forces and fields affect electric charges SWBAT describe how electric charges are transferred and explain why electric discharges occur	Generator Presentation – electric charge and static electricity Guided/individual practice – conceptual problems	– Winshurst Generator Analysis Classwork/ Homework – electric charge conceptual problems	MP.2 MP.4 HSA-CED.A.4
Electric Current and Ohm's Law	5 days	SWBAT describe electric current and identify the two types of current SWBAT describe conduction and classify materials as good electrical conductors of good electrical insulators SWBAT identify the factors that	Demonstration – Conductors and insulators Presentation – Electric Current and Ohm's Law Guided/individual practice – conceptual problems and Ohm's Law problems Ohm's Law Lab	Demonstration – conductors and insulators analysis Classwork/ homework – conceptual problems and Ohm's Law Problems Ohm's Law Lab analysis	HS-PS2-4 HS-PS3-1 HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

		affect resistance SWBAT explain how voltage produces electric current SWBAT calculate voltage, current, and resistance using Ohm's Law			
Electric Circuits	5 days	SWBAT analyze circuit diagrams for series circuits and parallel circuits SWBAT apply Kirchoff's Rules SWBAT solve equations that relate electric power to current, voltage, and electrical energy SWBAT describe devices and procedures	Demonstration – electric circuits Presentation – electrical circuits Guided/Individual practice – circuit diagrams and Ohm's Law Series and Parallel Circuits Lab	Electric Circuits Demonstration analysis Classwork/ homework – circuit diagrams and Ohm's Law Series and Parallel Circuits Lab Analysis	HS-PS2-4 HS-PS3-1 HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

		for maintaining electrical safety			
Review and Assessment	3 days	TSW apply their knowledge of Electricity to complete a review and unit assessment	Review – guided/ individual conceptual problems and algebraic problems Assessment	Classwork/ homework – review Assessment	HS-PS2-4 HS-PS3-1 HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

9-12.HS-PS2	Motion and Stability: Forces and Interactions
9-12.HS-PS3	Energy

Suggested Modifications for Special Education, ELL and Gifted Students

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- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
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elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- 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
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Unit 12: Magnetism

Content Area: **Science**
Course(s): **Physics(6)**
Time Period: **4th Marking Period**
Length: **14 Days**
Status: **Published**

Summary of the Unit

The magnetic field exerts a force on a moving electrically charged object. That magnetic force is perpendicular to the direction of the velocity of the object and to the magnetic field. The magnetic field vectors are tangent to concentric circles centered around a wire that carries an electric current. This unit allows students to determine the direction of the magnetic field created by a current carrying a wire. Students will also determine how to find the force exerted by a magnetic field on a moving charged particle or current carrying a wire.

Enduring Understandings

- A magnetic field is caused by a magnet or a moving electrically charged object.
- The magnetic field exerts a force on a moving electrically charged object.
- A magnetic force results from the interaction of a moving charged object or a magnet with other moving objects or another magnet.
- Electromagnetic forces are exerted at all scales and can dominate the human scale.

Essential Questions

- Both electric and magnetic forces will cause objects to repel and attract each other. What are the differences and origins of these forces?
- A magnet has a North and South Pole. If you cut the magnet in half, what happens to the 2 pieces?
- Do magnets exist with just a North Pole?
- What field circles a current carrying wire?

Summative Assessment and/or Summative Criteria

The tools used to assess the following criteria for mastery will be, but are not limited to: Quarterly exam, topic quizzes, chapter tests, projects, worksheets, and laboratory experiments.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources:

- New Jersey Center for Teaching and Learning: *http://njctl.org*
- American Association for the Advancement of Science: *http://www.aaas.org/programs*
- American Chemical Society: *http://www.acs.org/content/acs/en/education.html*
- Concord Consortium: Virtual Simulations: *http://concord.org/*
- International Technology and Engineering Educators Association: *http://www.iteaconnect.org/*
- National Earth Science Teachers Association: *http://www.nestanet.org/php/index.php*
- National Science Digital Library: *https://nsdl.oercommons.org/*
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: *http://www.naaee.net/*
- Phet: Interactive Simulations*https://phet.colorado.edu/*
- Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Unit Plan with Associated Standards Chart

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	New Jersey Student Learning Standards
Magnets and Magnetic Fields	2 days	SWBAT describe the effect of magnetic forces and magnetic fields SWBAT explain how magnetic poles determine the direction of magnetic force SWBAT interpret diagrams of magnetic field	Magnet Demonstration Presentation – magnets and magnetic fields Guided/individual practice – conceptual problems and magnetic field line diagrams Magnets Lab	Magnet Demonstration Analysis Classwork/ homework – conceptual problems and magnetic field line diagrams Magnets Lab analysis	HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

		lines around one or more bar magnets SWBAT describe Earth's magnetic field and its effect on compasses SWBAT explain the behavior of ferromagnetic materials in terms of magnetic domains			
Electromagnetism	5 days	SWBAT determine how a moving electric charge creates a magnetic field SWBAT determine the direction of the magnetic field created by a current-carrying wire SWBAT relate the force a magnetic field exerts on a moving electric charge to the type of charge and the direction of its motion SWBAT determine the force exerted by	Presentation – Electromagnetism Guided/individual practice – calculating magnitude of magnetic force and of the magnetic field Magnetic field Maps lab Presentation – Utilizing electromagnetic devices Guided/individual practice – utilizing electromagnetic devices	Classwork/ homework – calculating magnitudes of magnetic forces and magnetic fields Magnetic Field Maps Lab analysis Classwork/ homework – utilizing electromagnetic devices conceptual problems	HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

		a magnetic field on a moving charged particle or a current-carrying wire SWBAT explain how solenoids and electromagnets are constructed and describe factors that affect the field strength of both SWBAT describe how electromagnetic devices use the interaction between electric currents and magnetic fields			
Electrical Energy Generation and Transmission	2 days	SWBAT describe how electric current is generated by electromagnetic induction SWBAT compare AC and DC generators and explain how they work SWBAT analyze factors that determine the output voltage and current produced by a	Demonstration – electromagnetic induction Presentation – electrical energy generation and transmission Guided/individual practice – conceptual problems	Electromagnetic Induction demonstration analysis Classwork/ homework – conceptual problems	HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

		transformer SWBAT summarize how electrical energy is produced, transmitted, and converted for use in the home			
Review and Assessment	3 days	TSW apply their knowledge of Magnetism to complete a formal review and Magnetism Assessment	Guided/individual practice for Review – mathematical and conceptual problems Assessment	Review – mathematical and conceptual problems Assessment	HS-PS3-2 HS-PS3-5 MP.2 MP.4 HSA-CED.A.4

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