CP-Freshman Physics Curriculum Map 2024

updated 9/24/2024

Pacing Guide			
Unit	**Topics**	**Time Frame**	**Standards**
Preliminary Skills	❑ Accurate Measuring and Precise Rounding ❑ SI Units	4 Periods	HS-PS2-1
Kinematics	❑ Displacement and Velocity ❑ Acceleration and Free Fall	12 Periods 8 Periods	HS-PS2-1
Dynamics	❑ Force and its Representation ❑ Newton's 3 Laws	10 Periods 9 Periods	HS-PS2-1
Energy	❑ Types of Energy	12 Periods	HS-PS3-1, HS-PS3-2
Momentum	❑ The Law of Momentum Conservation	8 Periods	HS-PS2-2, HS-PS2-3
Simple Harmonic Motion (SHM)	❑ Frequency and Period ❑ Mass-Spring System ❑ Simple Pendulum	9 Periods	HS-PS4-1
Waves	❑ Characteristics ❑ Properties ❑ Standing Waves ❑ Sound Waves ❑ EM Waves	14 Periods	HS-PS4-1
Electricity	❑ Charge, force, and field ❑ Current/voltage/resistance ❑ Circuits: Series vs Parallel	18 Periods	HS-PS2-5

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Unit 1 Summary: Kinematics (Parts 1 and 2)

Kinematics is a branch of physics that describes ***how*** objects move. How something moves can be expressed as words, measurements, diagrams, equations, and/or graphs. These descriptions can be scalar (magnitude only) or vector (magnitude and direction) in nature. In this unit, students will learn the major kinematics terms (distance, displacement, speed, velocity, and acceleration) and how they are used to describe the motion of an object. This unit will emphasize the importance of using motion diagrams, graphical analysis, and equations to describe and predict the motion of an object. Students will use a combination of student inquiry, data collection, simulation work, and video analysis to strengthen their conceptual understanding of these terms as they pertain to motion.

This unit will be broken into two major topics with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The suggested number of periods for each lesson is indicated in parentheses.

1. Introduction to Motion: (Total 12 Periods)
    a. Scalar/Vectors, DIstance/Displacement,
    b. Speed/Velocity
    c. Describing Motion with DIagrams and Graphs
2. Acceleration: (Total 8 Periods)
    a. Acceleration and Free Fall,
    b. Describing Acceleration with Diagrams and Graphs
    c. Vertical/Horizontal Directions with Equations **(#1 only)**
        i. #1 $V_f = V_i + at$
        ii. #2 $\Delta x = 0.5(V_f + V_i)t$
        iii. #3 $\Delta x = V_i t + 0.5at^2$
        iv. #4 $V_f^2 = V_i^2 + 2a\Delta x$

Essential Questions:

How do scalar measurements differ from vector measurements?
Which aspects of an object's motion can be described using a motion diagram?
Which aspects of an object's motion can be described using a position-time graph?
Which aspects of an object's motion can be described using a velocity-time graph?
How are kinematics equations and graphs used to describe an object's motion in free-fall?

Vocabulary/Key Terms

Tier 2	Tier 3
distance, magnitude, direction, position, speed, vector, scalar	displacement, velocity, acceleration, Free-Fall

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Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Kinematics Part 1: Scalar/Vector, Displacement (x_f-x_i), Velocity, Position Motion Diagrams and Graphs
- Kinematics Part 2: Acceleration, Free Fall, Velocity Motion Diagrams, and Graphs

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Part 1: Constant Velocity Lab☆ (either bowling ball or constant car buggy)
- Part 1: Graph Matching Lab☆
- Part 2: Moving Man pHet Simulation
- Part 2: Free Fall to find g Lab
- Part 2: Stomp Rocket Lab☆
- Part 2: Motion Diagram Project

Practice (Homework/Classwork = 10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments part 1 and practice assignments part 2 which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:

Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Kinematics Chapter.

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Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
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	**Mathematics -** MP.2: Reason abstractly and quantitatively.	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
	MP.4: Model with mathematics.	9.3.ST-ET.2 Display and communicate STEM information
	HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
	HSA.SSE.A.1: Interpret expressions that represent a quantity in terms of its context.	
	HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	
	HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems.	
	HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	HSF-IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using	

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	technology for more complicated cases.
	ELA- RI.CT.9-10.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) seminal and informational text of historical and scientific significance, including how they relate in terms of themes and significant concepts
	W.IW.9-10.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content
	W.RW.9–10.7. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Sample Measurable Objectives for Lesson Planning
Determine whether a mathematically described quantity is scalar or vector
Determine the distance traveled and displacement of an object
Determine the average speed and/or velocity of a moving object for a given time interval
Use a motion diagram to describe how an object is moving (direction, type, and relative size)
Interpret an object's motion from a position-time graph
Calculate the velocity of a moving object from a position-time graph
Determine whether an object is accelerating
Describe the acceleration due to gravity
Describe the characteristics of a true free-falling object
Use a vector diagram to determine whether an object is accelerating and the direction of the acceleration
Interpret an object's motion from a velocity-time graph
Calculate the acceleration of a moving object from a velocity-time graph
Describe the motion of free-falling objects using velocity-time graphs
Describe the motion of objects using equations

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Unit 2 Summary: Dynamics (Parts 1 and 2)

Newton's Laws describe ***why*** an object is moving in a particular way. In this unit, students will learn the concept of force as a push or a pull and the major types of forces. This unit will examine in full detail each of Newton's Three laws of motion. These laws are commonly misunderstood and often lead to faulty conclusions in explaining the behavior (i.e. forces sustain motion) of an object or a system of objects. In order to fully understand why an object moves the way it does, students will learn how to select an object of interest, identify all external forces acting on that object, and construct a force diagram to represent the interactions that will lead to the changes in motion of the object. By the conclusion of this unit, students will be expected to be able to make qualitative and quantitative predictions about how an object will move as it interacts with its surroundings. Students will use a combination of student inquiry, data collection, simulation work, and video analysis in order to observe each of Newton's Laws in action in order to correct previous misconceptions and to learn how to use mechanics as a problem solving tool when studying advanced situations.

This unit will be broken into four major topics with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. Force and its Representation (Total 10 Periods)
    a. Weight, Normal, Friction, Tension, Applied, and Air Resistance
    b. Free-body Diagrams
    c. Balanced and Unbalanced with Net Force
2. Newton's 3 Laws of Motion (Total 9 Periods)

Essential Questions:

What is a force and how can it be represented in a diagram?
Which aspects of an object's motion are related to force?
How does inertia relate to an object's motion?
How does Newton's laws explain the principles of force and motion?

Vocabulary/Key Terms

Tier 2	Tier 3
action, reaction, force, friction, tension, normal, mass, weight, gravity	Free-body diagrams, acceleration due to gravity

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Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Newton's Laws: Inertia and Force Representations
- Newton's Laws: First, Second and Third Law

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Basic Forces Lab
- Part 1: What's Your Weight on...?☆
- Part 1: Scenarios of Free-Body Diagrams☆
- Part 2: Inertia Rings Activity☆
- Part 2: Newton's Second Law Lab☆
- Newton's Third Law Lab

Practice (Homework/Classwork = 10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments part 1 and practice assignments part 2 which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:

Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Dynamics Chapter.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students

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[At Risk Students]
[Gifted and Talented]

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
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	**Mathematics** - MP.2: Reason abstractly and quantitatively.	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
	MP.4: Model with mathematics.	9.3.ST-ET.2 Display and communicate STEM information
	HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
	HSA.SSE.A.1: Interpret expressions that represent a quantity in terms of its context.	
	HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	
	HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems.	
	HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	HSF-IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	
	ELA- RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single	

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	text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
	W.IW.9–10.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
	W.RW.9–10.7. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Sample Measurable Objectives for Lesson Planning
Predict the future motion of an object when provided with or without an unbalanced force
Use the concept of inertia to predict the motion of a light object compared to a heavy object
Predict whether an object will accelerate when provided with forces that are applied to it
List the individual forces acting on an object from a written description of the object's motion
Construct a free-body diagram for an object from a written description of the object's motion
Use a force diagram to determine the net force acting on an object
Use Newton's Second Law to calculate the acceleration of an object, given the object's mass and size of the net force
Calculate an object's acceleration when multiple forces are acting upon it
Calculate individual forces acting on an object when provided with the object's mass
Describe Newton's Third Law of Motion
Identify action-reaction force pairs in an interaction between a group of objects

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Unit 3 Summary: Energy

Energy can be defined as the ability to do work. Mechanical energy is described as energy associated with the motions or position of large scale objects. In this unit, three forms of mechanical energy will be examined: kinetic energy, gravitational potential energy, and elastic potential energy. Forces that are conservative have potential energies associated with them and will not change the total mechanical energy of a system, regardless of the path that was taken as the objects changed their positions. Examples of conservative forces include gravity, elastic, and electrical forces. When these types of forces are the only forces acting on a system, the law of conservation of mechanical energy can be applied.

This unit will be broken into one major topic with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. Energy (Total 12 Periods)
    a. Gravitational Potential Energy (GPE)/Elastic Potential Energy (EPE)
    b. Kinetic Energy (KE)
    c. Mechanical Energy (ME)-Conservation of Energy

Essential Questions:

When is work done on an object?
How are work and power related?
What are the major forms of energy?
What factors influence the potential and kinetic energy of an object?
How is energy conserved when changing from one form to another?

Vocabulary/Key Terms

Tier 2	Tier 3
energy, mass, gravity, kinetic, potential, mechanical	conservation of energy

Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Roller Coaster Project
- **Energy Test**
- **Energy Test Key**

Quizzes (20%)

- GPE/EPE
- KE

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Energy Video Analysis

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- Conservation of Mechanical Energy
- Marble Launcher
- Energy Skate Park Lab: pHet Qualitative Analysis ☆

Practice (Homework/Classwork = 10%)
Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:
Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Energy Chapter.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
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.	**Mathematics**- MP.2: Reason abstractly and quantitatively.	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
HS-PS3-2: Develop and use models to illustrate that	MP.4: Model with mathematics.	9.3.ST-ET.2 Display and communicate STEM

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energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).		information
	HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
	ELA- SL.II.9–10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.	
	W.WR.9–10.5. 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.	

Sample Measurable Objectives for Lesson Planning
Describe potential energy as energy stored due to position
Differentiate between gravitational potential energy and elastic potential energy
Calculate an object's potential energy
Describe kinetic energy as energy due to an object's motion
Calculate an object's kinetic energy
Determine the change in position and/or velocity of an object that is experiencing only internal (conservative) forces
Describe the mechanical energy of an isolated system using position and/or velocity.
Calculate the mechanical energy of an isolated system.

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Unit 4 Summary: Momentum

Momentum is the product of an object's mass and velocity. The total momentum of a closed system is always conserved and can therefore be used to predict the motion of objects before or after a collision. When an object imparts a force on another object, the total momentum of the objects will be changed. A change in an object's momentum is called impulse and is the product of the average force that is imparted on an object and the duration in which the force was applied. This unit will also look at quantities that are conserved in collisions between objects within a system. While it is true that momentum and total energy are always conserved in these interactions, mechanical energy is not. In an elastic collision, molecular and atomic arrangements of the objects involved in the interaction are not altered and therefore, mechanical energy will be conserved. In an inelastic collision, energy is needed to alter the molecular and atomic arrangement within the system, thereby altering the total kinetic energy of the system.

This unit will be broken into one major topic with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. The Law of Momentum Conservation (Total 8 Periods)
    a. Introduction to Momentum
    b. Conservation of Momentum (no impulse)/Elastic Collisions
    c. Perfectly Inelastic Collisions

Essential Questions:

What is momentum?
How can the momentum of an object be changed?
How does momentum change during collisions?
Does the law of conservation of momentum apply to explosions?
How can impulse and momentum be applied to everyday situations?

Vocabulary/Key Terms

Tier 2	Tier 3
mass, velocity, momentum, collision	conservation of momentum

Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Momentum
- Key Momentum Test

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Conservation of Momentum
- Momentum Observation Lab ☆

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Practice (Homework/Classwork =10%)
Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:
Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Momentum Chapter.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
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.	**Mathematics -** MP.2: Reason abstractly and quantitatively.	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
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.	MP.4: Model with mathematics.	9.3.ST-ET.2 Display and communicate STEM information
	HSN.Q.A.1: Use units as a way to understand problems and to	**Technology-**

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	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.	8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
	HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems.	
	HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	ELA- W.WR.9–10.5. 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.	

Sample Measurable Objectives for Lesson Planning
Describe momentum as how difficult it is to bring an object to rest or “mass in motion”
Calculate the momentum of an object
Apply Newton’s Laws to collisions
Explain that the total momentum of a closed system remains constant
Calculate for missing variables using a momentum table
Solve problems involving conservation of momentum
Describe qualitatively the expected result of an interaction using momentum conservation

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Unit 5 Summary: Simple Harmonic Motion (SHM)

Simple harmonic motion (SHM) is a type of periodic motion where there are restoring forces using the behavior in pendulums and springs. SHM investigates the factors that are relevant to the SHM of springs (mass, and spring constant) and pendulums (gravity and length). The motion of an oscillating object can be related to UCM. SHM can be represented using Hooke's Law, where the net force acting on the object is proportional to the displacement of that object.

This unit will be broken into one major topic with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. Simple Harmonic Motion: (Total 9 Periods)
    a. Frequency vs. Period
    b. Mass-Spring System
    a. Simple Pendulum

Essential Questions:

What are the differences between period and frequency?
What is the relationship between mass, spring constant, period, and frequency of a vibrating spring?
What is the relationship between gravity, length, period, and frequency of a pendulum?

Vocabulary/Key Terms

Tier 2	Tier 3
oscillation, spring, force, harmonic	pendulum

Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Simple Harmonic Motion

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Oscillating Spring Lab ☆
- Pendulum Lab ☆

Practice (Homework/Classwork =10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual

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tasks. Students will be provided with practice assignments which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:
Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI SHM Chapter.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
HS-PS4-1.: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	**Mathematics -** MP.2: Reason abstractly and quantitatively.	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
	MP.4: Model with mathematics.	9.3.ST-ET.2 Display and communicate STEM information
	HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSN.Q.A.2: Define appropriate quantities for the purpose of	8.1.12.DA.5 Create data visualizations

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	descriptive modeling.	from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	ELA- W.WR.9–10.5. 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.	
	SL.II.9–10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.	

Sample Measurable Objectives for Lesson Planning
Describe the relationship between period and frequency
Describe vibrational motion in terms of restoring force and equilibrium position
Analyze data to determine relationships between mass, spring constant, period, and frequency of a vibrating spring
Analyze data to determine relationships between gravity, length, period, and frequency of a pendulum

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Unit 6 Summary: Waves

A wave is propagated by a source that is vibrating in SHM and carries energy from one point to another without actually transferring matter itself between the two points. Mechanical waves require a medium to transfer energy. Electromagnetic waves do not require a medium to transfer energy. Waves in which the medium vibrates perpendicular to the wave's motion are called transverse waves, whereas waves in which the medium vibrates parallel to the direction of the wave are considered to be longitudinal. Parts of a wave can be observed and measured (wavelength, amplitude, frequency, and period). The speed of a wave is the product of the frequency and wavelength of the wave. The speeds of waves are influenced by other factors (such as moving sources) and changing these speeds will influence the wavelength of the wave. A sound wave is a longitudinal wave that exhibits all of the characteristics and experiences all of the interactions listed above. The perceived change in frequency of sound waves from moving sources is known as the Doppler effect.

This unit will be broken into one major topic with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. Waves (Total 14 Periods)
    a. Characteristics of a Wave
    b. Properties of a Wave-Reflection/Transmission/Interference
    c. Standing Wave
    d. Sound Waves-Beat Frequency/Doppler Effect
    e. Electromagnetic Waves

Essential Questions:

What are the properties of an object in vibrational motion?
How do force and energy apply to vibrational motion?
What factors affect the period of a vibrating object?
What are the defining characteristics of wave motion?
What are the properties of waves?
How do waves interact with each other?
How do transverse waves differ from longitudinal waves?
What happens when two sound waves interact?
What happens when either the source of a sound or the observer moves?
How does light behave like a wave?
How do we identify the electromagnetic spectrum?
How does wave speed relate to frequency?

Vocabulary/Key Terms

Tier 2	Tier 3
wave, crest, trough, frequency, wavelength, transverse, longitudinal	Doppler Effect, reflection, rarefaction, compression, inverse, spectroscope

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CP-Freshman Physics Curriculum Map 2024

Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Waves

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- Drawing Transverse Waves ☆
- Spectroscope Lab ☆

Practice (Homework/Classwork = 10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:

Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Waves Chapter.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

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STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
HS-PS4-1.: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	**Mathematics -** MP.2: Reason abstractly and quantitatively. .	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
	MP.4: Model with mathematics	9.3.ST-ET.2 Display and communicate STEM information
	HSA-SSE.A.1: Interpret expressions that represent a quantity in terms of its context.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSA-SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	ELA- W.WR.9–10.5. 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.	
	SL.II.9–10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.	

Sample Measurable Objectives for Lesson Planning
Determine the period, frequency, and amplitude of a vibrating object
Describe a wave as a disturbance that transfers energy
Identify the parts of transverse and longitudinal waves
Categorize waves as longitudinal or transverse
Calculate period and frequency
Relate the amplitude of a wave to the energy it carries
Identify the variables that affect the speed of a wave
Describe the speed of a wave in terms of period, frequency, and wavelength
Calculate the speed of a wave using the wave equation
Describe the behavior of a wave when it encounters a boundary
Define and describe reflection, refraction, and diffraction of waves
Describe how the Doppler effect changes how we hear sounds

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Identify types of electromagnetic waves and their uses
Describe the relationship between the amount of energy and the wavelength and frequency along the electromagnetic wave spectrum.

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Unit 7 Summary: Electricity

A student touches an electroscope with his hand at the same time he brings a positively charged rod close to the electroscope without touching. When he removes his hand first and then moves the rod away from the electroscope, the leaves move apart. This phenomenon can be explained through the study of electric charges, forces, and fields. Resistivity and other factors can be used to determine the resistance of an object. Electric potential is a measurement of potential energy per unit of charge. Current is the amount of charge that flows through a material in a given period of time. Resistance, current, and potential difference are related by Ohm's Law and states that potential difference is the product of resistance and current. All resistors in electric circuits are governed by Ohm's Laws. Electric circuits are pathways for electric current to follow and can be wired in series (one path for current), parallel (multiple paths for current), or a combination of the two. Each of these circuits will be analyzed in terms of conservation of energy and charge.

This unit will be broken into three major topics with varying numbers of subtopics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor. The number of days for each lesson is indicated in parentheses.

1. Electricity: (Total 18 Periods)
    a. Electric charge and force (no calculations)
    b. Electric field and potential (no calculations)
        i. Voltage
    c. Electric current and circuits (including calculations)
        i. Ohm's Law and Resistance
        ii. Schematics and Series and Parallel Circuits

Essential Questions:

How many types of electric charge are there? What are they named?
What are the different ways that objects could become charged?
What is the definition of the Electric Field?
What are voltage, current, and resistance?
How is Ohm's Law used to determine current, voltage, or resistance of a resistor?
What is the difference between series and parallel circuits?

Vocabulary/Key Terms

Tier 2	Tier 3
current, resistance, voltage, amperes, resistor, battery, series, parallel	Circuit

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CP-Freshman Physics Curriculum Map 2024

Evidence of Learning:

Summative/Performance Assessments (Tests/Projects = 40%)

- Electricity through Series and Parallel Circuits

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. While many sample labs will be listed here, only those denoted with a ☆ will be required.

- pHet (travoltage)
- pHet (balloons and static electricity)
- Inquiry battery/bulb/wire
- snap boards ☆
- potato light bulb

Practice (Homework/Classwork = 10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard responses, and student polling. The usage of Concept Builders will be used for students and instructors to gauge student performance on conceptual tasks. Students will be provided with practice assignments which will be modified over time to help work with conceptual examples. Other materials that can be used include, but are not limited to:

- Pivot Interactives
- Desmos Graphing Activities
- Physics Interactives
- Physics Aviary Tasks
- PhET Simulations

Formative Assessments:

Student progress will be assessed on a daily basis through ***Objective Checkpoint*** questions embedded in the lesson presentations. Concept Builders will be used at the conclusion of lessons (as homework or classwork) to check for individual student mastery. Small quizzes should be administered after every lesson or couple of lessons.

Resources

Content and structure of this course is based on the material as presented by The Physics Classroom and PSI Electric Charge and Force, Electric Field and Potential, and Current and Circuits Chapters.

Science Recommended Accommodations & Modifications for Curriculum Implementation

General Classes
Special Education
504 Students
ML Students
At Risk Students
Gifted and Talented

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CP-Freshman Physics Curriculum Map 2024

STANDARDS for Learning Targets		
NGSS	**Cross curricular**	**CTE(NJSLS 9) Technology(NJSLS8)**
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.	**Mathematics -** MP.2: Reason abstractly and quantitatively. .	**CTE-** 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
	MP.4: Model with mathematics	9.3.ST-ET.2 Display and communicate STEM information
	HSA-SSE.A.1: Interpret expressions that represent a quantity in terms of its context.	**Technology-** 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
	HSA-SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
	HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
	ELA- W.WR.9–10.5. 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.	
	SL.II.9–10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.	

Sample Measurable Objectives for Lesson Planning
Describe electricity and electrical charge
Identify the 3 main methods of charging an object
Draw electric field lines
Calculate resistance, voltage, and current using Ohm's Law
Apply Ohm's Law to series circuits
Apply Ohm's Law to parallel circuits

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