Honors Freshman Physics Curriculum Map 2024

updated 9/24/24

Unit	Topics	Time Frame	Standards
Preparatory Skills and Practices	❑ Experiments and Variables ❑ Proportional Reasoning ❑ Using Graphs (Intercepts and Slopes) ❑ Visualizing Relationships (Graphical Relationships)	6 periods	HS-PS2-1
Describing Motion (Kinematics)	❑ Describing Motion with Words ❑ Describing Motion with Diagrams ❑ Position vs. Time Graphs ❑ Velocity vs. Time Graphs ❑ Free-Fall and Acceleration due to Gravity ❑ Describing Motion with Equations	25 periods	HS-PS2-1
Newton's Laws	❑ Newton's First Law ❑ Force and its Representation ❑ Newton's Second Law ❑ Newton's Third Law	25 periods	HS-PS2-1
Work and Energy	❑ Basic Terminology and Concepts ❑ The Work-Energy Relationship	15 periods	HS-PS3-1, HS-PS3-2, 
Momentum	❑ The Impulse-Momentum Change Theorem ❑ The Law of Momentum Conservation	15 periods	HS-PS2-1, HS-PS2-3
UCM and Gravitation	❑ Motion Characteristics for Circular Motion ❑ Applications of Circular Motion ❑ Universal Gravitation	13 periods	HS-PS2-1, HS-PS2-4
Waves	❑ Vibrations ❑ The Nature of a Wave ❑ Properties of a Wave ❑ Behavior of Waves ❑ Standing Waves	23 periods	HS-PS4-1
Electricity	❑ Electrical Variables ❑ Electrical Laws ❑ Electric Circuits	20 periods	HS-PS2-5, 

Honors Freshman Physics Curriculum Map 2024

Preliminary Unit Summary: Physics Skills and Practices

THe study of physics involves understanding the relationships between physical quantities. The laws of physics are governed by many equations that explain why objects and systems behave the way they do. Physicists conduct controlled experiments in order to determine whether physical quantities are dependent on one another. Devising an experiment in which only two variables will be involved is a paramount skill in physics. Once an experiment is properly performed, data must be analyzed. Graphing is an essential skill when trying to determine whether variables are related and, if they are, specifically how they are related. Students will examine some of the more basic relationships in this course: direct (linear), inverse, square (quadratic), square root, and inverse square. In this unit, students will design experiments when presented with a scientific question, conduct the experiment, and use a graph to determine the relationship between tested variables.

This unit will be broken into four major topics. Each lesson will be supplemented with various activities and labs that will be selected by the individual instructor.

1. Experiments and Variables
2. Proportional Reasoning
3. Using Graphs (Slope and Intercepts)
4. Visualizing Relationships

Essential Questions:

What are independent and dependent variables?
How can data be interpreted and analyzed?
How do you determine the slope of a line?
What is the meaning of the slope of a line?

Vocabulary/Key Terms

Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
independent, dependent, analyze, data	**variable, slope, intercept**

Evidence of Learning:

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

- Physics Skills and Practices Assessment

Quizzes (20%)

Individual brief quizzes are provided in the lesson folder for each specific topic. Teachers can also use their own quizzes to assess for deeper or more specific understanding

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least one lab*** in which real-life equipment is utilized. Example labs can be found in this folder (more labs will be added to this folder as they are created).

Back to top

- Circumference and Diameter of a Cylinder Lab
- Mass and Volume of a Liquid Lab
- The Cost of Gasoline 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 a unit packet, 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

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.

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		
NJSLS Science	**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	ELA Standards **RI.MF.9-10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9-10.4:** Present information, findings, and supporting	CTE Standards **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field.

Back to top

evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

SL.UM.9–10.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest..

L.KL.9–10.2: Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.

Mathematics Standards

Standard: Creating Equations

A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions

A.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Standard: Making Inferences and Justifying Conclusions

S.IC.B.6: Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

.

Standard: Interpreting Categorical and Quantitative Data

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

9.3.ST-ET.1: Use STEM concepts and processes to solve problems involving design and/or production.

9.3.ST-ET.2: Display and communicate STEM information.

9.3.ST-ET.3: Apply processes and concepts for the use of technological tools in STEM

9.3.ST-ET.5: Apply the knowledge learned in STEM to solve problems.

9.3.ST-SM.1: Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better
understand real world phenomena, including climate change.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and
support different interpretations of real-world phenomena.

Back to top

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

Sample Measurable Objectives for Lesson Planning
Identify the independent and dependent variables from a given scientific purpose
Devise a procedure that will best address a scientific purpose
Select the best representation of a graph that will be used to address a scientific purpose
Identify quantities from a data set that follow a pattern of proportionality
Identify a proportionality from a data set and predict a value outside of the data range
Use a digital application (Demos, Excel, Graphing Calculator) to determine the type of proportionality between tested variables
Determine the slope (including the units) of a best-fit line
Quantitatively explain the meaning of the slope of proportional graph in terms of the independent and dependent variables
Determine which data representation (table, words, equation, or graph) are unlike from a list of three or four possible representations

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 1 Summary: Describing Motion

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 (size only) or vector (size 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 six 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 links below will take the user to a folder that consists of presentations, worksheets, formative questions, and section quizzes for each major unit section.

1. Describing Motion with Words
2. Describing Motion with Diagrams
3. Describing Motion with Position-Time Graphs
4. Describing Motion with Velocity-Time Graphs
5. Free Fall and Acceleration Due to Gravity
6. Describing Motion with Equations

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 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
distance, magnitude, direction, position, speed, vector, scalar	**displacement, velocity, acceleration**

Back to top

Honors Freshman Physics Curriculum Map 2024

Evidence of Learning:

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

- Kinematics: Terms and Diagrams
- Kinematics: Graphical Analysis
- Kinematics: Freefall and Mathematical Analysis

Quizzes (20%)

Individual brief quizzes are provided in the lesson folder for each specific topic. Teachers can also use their own quizzes to assess for deeper or more specific understanding

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least three labs*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: Describing Motion with Words
- Labs for Topic 2: Describing Motion with Diagrams
- Labs for Topic 3: Describing Motion with Position-Time Graphs
- Labs for Topic 4: Describing Motion with Velocity-Time Graphs
- Labs for Topic 5: Free Fall and Acceleration Due to Gravity
- Labs for Topic 6: Describing Motion with Equations

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. Practice examples will be based on a workbook provided by the Physics Classroom. Other materials that can be used include, but are not limited to:

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

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.

Back to top

Honors Freshman Physics Curriculum Map 2024

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

NJSLS Science	Cross curricular	CTE (NJSLS 9) Technology (NJSLS)
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	**ELA Standards** **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.. **L.KL.9–10.2:** Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening. **Mathematics Standards** **Standard: Creating Equations** **A.CED.A.1:** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions **A.CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	**CTE Standards** **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information. **9.3.ST-ET.3:** Apply processes and concepts for the use of technological tools in STEM **9.3.ST-ET.5:** Apply the knowledge learned in STEM to solve problems. **9.3.ST-SM.1:** Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities. **9.3.ST-SM.2:** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. **Technology** **8.1.12.DA.1:** Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

[Back to top]

A.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Standard: Making Inferences and Justifying Conclusions
S.IC.B.6: Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).
.

Standard: Interpreting Categorical and Quantitative Data
S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and
support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

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
Determine whether an object is accelerating
Determine the size and direction of an object's acceleration from motion data
Construct a diagram to accurately depict motion
Use a motion diagram to describe how an object is moving (direction, type, and relative size)
Use a vector diagram to determine whether an object is accelerating
Use a vector diagram to determine the direction of an object's acceleration
Determine the direction of an object's motion from a position-time graph
Determine whether an object is at rest, constant velocity, or accelerating from a position-time graph
Calculate the velocity of a moving object from a position-time graph
Determine the direction of an object's motion from a velocity-time graph
Determine whether an object is at rest, constant velocity, or accelerating from a velocity-time graph
Calculate the acceleration of a moving object from a velocity-time graph
Determine the displacement of a moving object from a velocity-time graph
Describe the characteristics of a true free-falling object
Describe the acceleration due to gravity
Describe the motion of free-falling objects using position-time and velocity-time graphs
Determine the displacement and speed of a free-falling object based on the time it has been falling
Explain that mass does not play a role in free fall
Describe the effects of air resistance on free-falling objects
Describe the motion of objects using equations
Solve kinematics problems using appropriate equations
Apply kinematics equations to objects in free fall

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 2 Summary: Newton's Laws

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.

1. Newton's First Law of Motion
2. Force and its Representation
3. Newton's Second Law of Motion
4. Newton's Third Law of Motion

Essential Questions:

How does inertia relate to an object's motion?
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 do Newton's laws explain the principles of force and motion?

Vocabulary/Key Terms

Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
opposite, action, reaction, force, tension, normal, mass, weight, gravity	**free-body diagram, inertia**

Back to top

Honors Freshman Physics Curriculum Map 2024

Evidence of Learning:

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

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

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least three labs*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: Newton's First Law of Motion
- Labs for Topic 2: Force and its Representation
- Labs for Topic 3: Newton's Second Law of Motion
- Labs for Topic 4: Newton's Third Law of Motion

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 a unit packet, 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

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.

Science Recommended Accommodations & Modifications for Curriculum Implementation

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

Back to top

Honors Freshman Physics Curriculum Map 2024

STANDARDS for Learning Targets		
NJSLS Science	**Cross curricular**	**CTE (NJSLS 9) Technology (NJSLS)**
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	**ELA Standards** **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.. **L.KL.9–10.2:** Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening. **Mathematics Standards** **Standard: Creating Equations** **A.CED.A.1:** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions **A.CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **A.CED.A.4:** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R. **Standard: Making Inferences and Justifying Conclusions** **S.IC.B.6:** Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed). . **Standard: Interpreting Categorical and Quantitative Data** **S.ID.A.1:** Represent data with plots on the real number line (dot plots, histograms, and box plots).	**CTE Standards** **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information. **9.3.ST-ET.3:** Apply processes and concepts for the use of technological tools in STEM **9.3.ST-ET.5:** Apply the knowledge learned in STEM to solve problems. **9.3.ST-SM.1:** Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities. **9.3.ST-SM.2:** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. **Technology** **8.1.12.DA.1:** Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. **8.1.12.DA.5**: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

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

Back to top

Honors Freshman Physics Curriculum Map 2024

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 and kinematic data
Calculate the acceleration of objects that fall in the air and compare them to objects that fall freely
Calculate the acceleration and/or individual forces acting on an object when multiple objects interact with each other
Describe Newton's Third Law of Motion
Identify action-reaction force pairs in an interaction between a group of objects

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 3 Summary: Work and Energy

In this unit, students will learn the concepts of work, mechanical energy, and power. Students will learn the different types of mechanical energy and to differentiate between open and closed systems. This unit will focus on students analyzing situations and determining if work was done and how energy was transferred. Students will use a combination of student inquiry, data collection, simulation work, and video analysis to strengthen their conceptual understanding of work and energy.

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.

1. Basic Terminology and Concepts
2. The Work-Energy Relationship

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 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
force, work, energy, power, mass, gravity, kinetic, potential, mechanical	

Evidence of Learning:

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

- Work and Energy

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least two labs*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: Basic Terminology and Concepts
- Labs for Topic 2: The Work-Energy Relationship

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 a unit packet, which will be modified over time to help work with conceptual examples. Other materials that can be

Back to top

Honors Freshman Physics Curriculum Map 2024

used include, but are not limited to:

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

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.

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

NJSLS Science	Cross curricular	CTE (NJSLS 9) Technology (NJSLS)
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. **HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).	ELA Standards **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.. **L.KL.9–10.2:** Apply knowledge of language to make	CTE Standards **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information. **9.3.ST-ET.3:** Apply processes and concepts for the use of technological tools in STEM

Back to top

effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.

Mathematics Standards

Standard: Creating Equations

A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions

A.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Standard: Making Inferences and Justifying Conclusions

S.IC.B.6: Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

.

Standard: Interpreting Categorical and Quantitative Data

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

9.3.ST-ET.5: Apply the knowledge learned in STEM to solve problems.

9.3.ST-SM.1: Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better
understand real world phenomena, including climate change.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and
support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

Sample Measurable Objectives for Lesson Planning
Describe work in terms of force and displacement
Calculate work done in given situations
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
Describe mechanical energy as the energy acquired when work is done on the object
Describe power as the rate at which work is done
Characterize forces as internal or external based on their ability to do work
Determine the change in mechanical energy of a system experiencing external forces
Determine the change in position and/or velocity of an object that is experiencing only internal (conservative) forces

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 4 Summary: Momentum

In this unit, students will learn the concepts of impulse and momentum. Students will study interactions between objects when momentum changes and when momentum is conserved. Students will apply Newton's Laws to collisions and apply impulse and momentum concepts to real world situations. Students will use a combination of student inquiry, data collection, simulation work, and video analysis to strengthen their conceptual understanding of momentum and impulse.

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.

1. The Impulse-Momentum Change Theorem
2. The Law of Momentum Conservation

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 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
mass, velocity, momentum, impulse, conserve, collision	

Evidence of Learning:

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

- Momentum

Quizzes (20%)

Labs (30%)

Lab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least two labs*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: The Impulse-Momentum Change Theorem
- Labs for Topic 2: The Law of Momentum Conservation

Practice (Homework/Classwork =10%)

Classwork will involve questioning techniques utilizing a variety of strategies. Student learning will be monitored using responder systems, whiteboard

Back to top

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 a unit packet, 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

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.

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		
NJSLS Science	**Cross curricular**	**CTE (NJSLS 9) Technology (NJSLS)**
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. **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.	ELA Standards **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and	CTE Standards **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information.

Back to top

to add interest..

L.KL.9-10.2: Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.

Mathematics Standards

Standard: Creating Equations

A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions

A.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Standard: Making Inferences and Justifying Conclusions

S.IC.B.6: Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

.

Standard: Interpreting Categorical and Quantitative Data

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions

F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

9.3.ST-ET.3: Apply processes and concepts for the use of technological tools in STEM

9.3.ST-ET.5: Apply the knowledge learned in STEM to solve problems.

9.3.ST-SM.1: Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

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
Describe impulse in terms of momentum change and force
Solve for missing variables using the impulse-momentum equation
Apply impulse-momentum theorem to real world situations
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
Identify if a system is isolated
Solve problems involving conservation of momentum
Describe qualitatively the expected result of an interaction using momentum conservation
Apply momentum conservation to explosions

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 5 Summary: Uniform Circular Motion and Gravitation

In this unit, students will learn that the same concepts and principles that are used to describe linear motion can be used to describe the motion of an object moving in a circular path. In this unit, students will learn the major circular motion terms and how they are used to describe the motion of an object in a circular path. Students will use a combination of student inquiry, data collection, simulation work, and video analysis to strengthen their conceptual understanding of circular motion.

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.

1. Motion Characteristics for Circular Motion
2. Applications of Circular Motion
3. Universal Gravitation

Essential Questions:

What are the properties of an object moving in a circular path?
How is uniform circular motion described?
What force causes an object to move in a circular path?
What factors affect centripetal force?
What is universal gravitation and what factors affect it?

Vocabulary/Key Terms

Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
circular, force, acceleration, mass	**centripetal**

Evidence of Learning:

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

- UCM and Gravitation Unit Test

Quizzes (20%)

Labs (30%)

LLab work will involve data collection using traditional data collection methods, sensor collection, video analysis, and/or simulation based material. Classes should conduct ***at least one lab*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: Motion Characteristics for Circular Motion
- Labs for Topic 2: Applications of Circular Motion
- Labs for Topic 3: Universal Gravitation

Back to top

Honors Freshman Physics Curriculum Map 2024

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 a unit packet, 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

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.

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		
NJSLS Science	**Cross curricular**	**CTE (NJSLS 9) Technology (NJSLS)**
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 **HS-PS2-4**.: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	ELA Standards **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual,	CTE Standards **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information.

Back to top

graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest..

L.KL.9–10.2: Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.

Mathematics Standards

Standard: Creating Equations

A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions

A.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Standard: Making Inferences and Justifying Conclusions

S.IC.B.6: Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

.

Standard: Interpreting Categorical and Quantitative Data

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions

9.3.ST-ET.3: Apply processes and concepts for the use of technological tools in STEM

9.3.ST-ET.5: Apply the knowledge learned in STEM to solve problems.

9.3.ST-SM.1: Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

	F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima. **Standard: Linear and Exponential Models** **F.LE.A.1B:** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **F.LE.A.1C:** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. **F.LE.A.3:** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. **F.LE.B.5:** Interpret the parameters in a linear or exponential function in terms of a context. **Standard: Quantities** **N.Q.A.1:** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

Sample Measurable Objectives for Lesson Planning
Describe the speed and velocity of an object moving in a uniform circular path
Explain why object moving in a circular path is always accelerating
Explain the presence of a centripetal force using Newton's Laws of motion
Determine if a force will cause an object's speed to change
Apply the law of inertia to disprove the presence of a "centrifugal force"
Solve for the speed, acceleration, and centripetal force of an object moving in a circular path
Use a free-body diagram to determine the centripetal force, acceleration and individual forces acting on an object
Analyze the forces acting on a rider at different positions on a roller coaster
Use force concepts to explain the feelings of weightlessness and heaviness during a roller coaster ride
Apply circular motion concepts to athletics
Describe the factors that affect the force of gravity
Use Newton's Law of Gravitation to solve for the gravitational force acting on an object
Describe the factors that affect gravitational field

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 6 Summary: Waves

In this unit, students will learn the properties of oscillating objects. Students will study the behavior of pendulums, springs, and waves. In this unit students will learn major terms associated with oscillatory motion (restoring force, amplitude, wavelength, frequency, and period) and use those terms to describe the motion of oscillating objects. 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 waves.

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.

1. Vibrations
2. The Nature of a Wave
3. Properties of a Wave
4. Behavior of Waves
5. Standing 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?
What is a standing wave and how are they formed?

Vocabulary/Key Terms

Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
oscillation, spring, force, restoring, harmonic, wave, reflection, frequency, wavelength	**pendulum**

Back to top

Honors Freshman Physics Curriculum Map 2024

Evidence of Learning:

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

- Waves: Vibrations and Wave Basics
- Waves: Behavior of 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. Classes should conduct ***at least two labs*** in which real-life equipment is utilized. More labs will be added to this folder as they are created.

- Labs for Topic 1: Vibrations
- Labs for Topic 2: The Nature of a Wave
- Labs for Topic 3: Properties of a Wave
- Labs for Topic 4: Behavior of Waves
- Labs for Topic 5: Standing Waves

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 a unit packet, 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

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.

Science Recommended Accommodations & Modifications for Curriculum Implementation

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

Back to top

Honors Freshman Physics Curriculum Map 2024

STANDARDS for Learning Targets		
NJSLS Science	**Cross curricular**	**CTE (NJSLS 9) Technology (NJSLS)**
HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	**ELA Standards** **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.. **L.KL.9–10.2:** Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening. **Mathematics Standards** **Standard: Creating Equations** **A.CED.A.1:** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions **A.CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **A.CED.A.4:** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R. **Standard: Making Inferences and Justifying Conclusions** **S.IC.B.6:** Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed). . **Standard: Interpreting Categorical and Quantitative Data**	**CTE Standards** **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information. **9.3.ST-ET.3:** Apply processes and concepts for the use of technological tools in STEM **9.3.ST-ET.5:** Apply the knowledge learned in STEM to solve problems. **9.3.ST-SM.1:** Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities. **9.3.ST-SM.2:** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. **Technology** **8.1.12.DA.1:** Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. **8.1.12.DA.5**: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Back to top

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays
.

Sample Measurable Objectives for Lesson Planning
Describe vibrational motion in terms of restoring force and equilibrium position
Determine the period, frequency, and amplitude of a vibrating object

Back to top

Honors Freshman Physics Curriculum Map 2024

Describe the restoring force acting on a pendulum
Describe the energy changes that occur throughout the motion of a pendulum
Identify the factors that affect the period of a pendulum
Describe the restoring force acting on a mass on a spring
Describe the energy changes that occur throughout the motion of a mass on a spring
Identify the factors that affect the period of a mass on a spring
Describe a wave as a disturbance that transfers energy
Categorize waves as longitudinal or transverse
Identify the parts of transverse and longitudinal waves
Define period and frequency
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 constructive and destructive interference of waves
Describe the Doppler Effect
Compare and contrast a traveling wave pattern and a standing wave pattern
Describe how standing waves are formed
Identify the nodes and antinodes in a standing wave
Identify the harmonic of a standing wave pattern
Calculate the wavelength of a standing wave

Back to top

Honors Freshman Physics Curriculum Map 2024

Unit 8 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.

1. Electricity:
    a. Electrical Variables
    b. Electrical Laws
    c. Electric 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 Vocabulary *High-frequency words used throughout the unit*	Tier 3 Vocabulary *Discipline-specific words used throughout the unit*
current, resistance, power, component, resistor, battery, series, parallel	**circuit**

Back to top

Honors Freshman Physics Curriculum Map 2024

Evidence of Learning:

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

- Electricity Unit 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.

- Electrical Magic Lab
- Electric Force vs. Distance Lab
- Resistance Lab
- Ohm's Law Lab
- Series Circuits Lab
- Parallel Circuits 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 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

Back to top

Honors Freshman Physics Curriculum Map 2024

Gifted and Talented

STANDARDS for Learning Targets		
NJSLS Science	**Cross curricular**	**CTE (NJSLS 9) Technology (NJSLS)**
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.	**ELA Standards** **RI.MF.9–10.6:** Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or texts presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. **SL.PI.9–10.4:** Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.UM.9–10.5:** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.. **L.KL.9–10.2:** Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening. **Mathematics Standards** **Standard: Creating Equations** **A.CED.A.1:** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions **A.CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **A.CED.A.4:** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R. **Standard: Making Inferences and Justifying Conclusions** **S.IC.B.6:** Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed). . **Standard: Interpreting Categorical and Quantitative Data**	**CTE Standards** **9.3.ST.2:** Use technology to acquire, manipulate, analyze and report data. **9.3.ST.6:** Demonstrate technical skills needed in a chosen STEM field. **9.3.ST-ET.1:** Use STEM concepts and processes to solve problems involving design and/or production. **9.3.ST-ET.2:** Display and communicate STEM information. **9.3.ST-ET.3:** Apply processes and concepts for the use of technological tools in STEM **9.3.ST-ET.5:** Apply the knowledge learned in STEM to solve problems. **9.3.ST-SM.1:** Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities. **9.3.ST-SM.2:** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. **Technology** **8.1.12.DA.1:** Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. **8.1.12.DA.5**: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Back to top

Honors Freshman Physics Curriculum Map 2024

S.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.B.6A: Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard: Interpreting Functions
F.IF.C.7A: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standard: Linear and Exponential Models
F.LE.A.1B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Standard: Quantities
N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

Sample Measurable Objectives for Lesson Planning
Describe electricity and electrical charge
Identify the 3 main methods of charging an object
Draw electric field lines

Back to top

Honors Freshman Physics Curriculum Map 2024

Calculate resistance, voltage, and current using Ohm's Law
Apply Ohm's Law to series circuits
Apply Ohm's Law to parallel circuits

Back to top