Hoboken Public Schools

Physics Curriculum

Physics

HOBOKEN PUBLIC SCHOOLS

Course Description

Physics is a physical science course specifically for students with a strong mathematical background beginning their high school science curriculum. Using physics as a unifying theme, topics will integrate a wide range of disciplines, both within and outside the "standard" science arena. The course will serve as: 1. A logical and natural continuation of previous science courses, incorporating both review of studied concepts along with an emphasis on the subsequent extensions of these concepts and topics, and the introduction of new advanced topics and concepts. 2. An opportunity to relate scientific concepts and principles to the everyday happenings of life and to other disciplines through examples and activities demonstrating these inter-relationships. 3. A means to provide a wide range of "hands-on" activities that will be exciting and challenging. 4. A necessary foundation to satisfy the state framework guides in science and technology and prepare for the Introductory Physics MCAS This course will expand the understanding of motion, energy conservation, thermodynamics (heat), waves (mechanical and electromagnetic), and electromagnetism. All topics will incorporate basic scientific practices and methods. Projects, both individual and group, laboratory experiments, and research will all be integral parts of the program.

Course Resources

- *Text :Pearson Education Inc.,* by Paul G. Hewitt (2015)
- Labware Supplies,
- Calculators,
- Smart Board
- LapTops/Chrome Books

Pacing Guide

Unit Titles	Time Frame
Unit One: Motion in One Dimension	**4 Weeks**
Unit Two: Motion in Two Dimensions	**5Weeks**
Unit Three: Forces and Newton's Law	**5 Weeks**
Unit Four: Momentum/Mechanical Energy	**7 Weeks**
Unit Five: Circular Motion and Gravitation	**5 Weeks**
Unit Six: Waves, Heat, and Energy	**5 Weeks**

Unit 1 – Motion in One Dimension

4 Weeks

Unit 1 Overview

In this unit, students will be able to define and calculate speed, distance and velocity and instantaneous speed of an object when given the change in position and time. Students will be able to identify an object's velocity by analyzing its motion. Students will also be required to calculate the average and

instantaneous velocity of an object. Students will learn how to determine an object's acceleration by analyzing its motion. Students will also be required to calculate average acceleration. Students will be able to calculate position, velocity, and acceleration using the kinematic equations. Students will understand how to create and interpret graphs of motion over time. **Reference frames and relative motions** – Students conclude the lesson by describing and comparing the motion of a single object in multiple reference frames.

Essential Questions

- How do you seem to lurch forward in a bus that suddenly slows? Why do you seem lurch backward when the bus picks up speed? What law applies here?
- A hockey puck slides across the ice at a constant speed. How would you consider that in the equilibrium? Explain?

Essential Learning Outcomes

- Students will be able to define and calculate speed, distance and velocity and instantaneous speed of an object when given the change in position and time.
- Students will be able to identify an object's velocity by analyzing its motion. Students will also be required to calculate the average and instantaneous velocity of an object.
- Students will learn how to determine an object's acceleration by analyzing its motion.
- Students will also be required to calculate average acceleration.
- Students will be able to calculate position, velocity, and acceleration using the kinematic equations. Students will understand how to create and interpret graphs of motion over time. **Reference frames and relative motions** – Students conclude the lesson by describing and comparing the motion of a single object in multiple reference frames.

Technology Infusion

8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

Standards Addressed

S-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-PS2-2	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.
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.
PS3.A	Identify and quantify the various types of energies within a system of objects in a well-

	PS3.B defined state, such as elastic potential energy, gravitational potential energy, kinetic energy, and thermal energy and represent how these energies may change over time
PS3.A	Calculate changes in kinetic energy and gravitational potential energy of a system using representations of that system
HS PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
HS PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-PS2-4	Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects

Differentiation

Learning Activity	Students Who Need More Support	Enrichment
Labs	➢ Assigned Role ➢ Frequent Check ins ➢ Heterogenous learnings levels within lab group ➢ Smaller group sizes ➢ Confirm understanding of lab procedure ➢ Lab instructions with visual support ➢ Pre- teach essential laboratory vocabulary ➢ Provided a graphic organizer of graphing procedure ➢ Teach self-regulation strategies	➢ Students should be asking their own questions ➢ Students should be designing their own experiments ➢ Students create questions for further investigation and study ➢ Students reflect on redesign of their experiment ➢ Students research and connect the lab experiment to a current science industry practices and real life applications
Blended Learning Rotational Model	➢ Differentiated small group instruction ➢ Differentiated formative assessment ➢ One-to-one computer based instruction/assessment ➢ Manipulative stations: visual support, kinesthetic learning, hands-on learning ➢ Differentiated reading and writing station (graphic organizers and brainstorming activities) ➢ Provide student leaders within each group ➢ Written directions at each station ➢ Teach self-regulation strategies	

Whole Group Instruction	➢ Provide guided notes ➢ Provide visual and auditory support ➢ Frequent check ins/close proximity monitoring ➢ Interactive lecture (question and answer for formative assessment and discussion) ➢ Summarize key points ➢ Introduce new vocabulary concepts before the lesson	➢ Ask higher level, open ended questions throughout lecture ➢ Asks students to make connections to current science industry practices and real life applications ➢ Ask student to prepare or lead a science lecture or learning activity ➢ Ask students to summarize key points/concepts

Assessments

- Laboratory Report,
- Lab Research Presentation
- Quizzes
- Exams
- PowerPoints Presentations
- Research Simulation Task
- Debate
- Problem Based Learning Activity Presentations
- Night Write

21st Century Learning Connection

- Creativity and Innovation-Students explain how scientific understanding builds on itself over time, and how advancements in science depend on creative thinking based on the knowledge and innovations of others.
- Critical Thinking and Problem Solving-Students understand that scientific research and experimentation are guided by fundamental concepts, and that investigations are conducted for different reasons, such as exploring new phenomena, building on previous results, comparing different theories, and addressing problems facing society.
- Communication and Collaboration-Students model the practices of research science by informing others about their work, developing effective explanations, constructing and defending reasoned arguments, and responding appropriately to critical comments about their explanations. Students can explain why mathematical equations and formulae are used as representations of scientific phenomena and as a means of communicating scientific ideas. Students collaborate with peers and experts during scientific discourse and appropriately defend arguments using scientific reasoning, logic, and modeling.
- Information Literacy-Students are able to determine the verifiability of evidence presented in print and electronic resources to evaluate scientific claims.
- Media Literacy-Students are able to critique claims that people make when they select only data that support the claim, and ignore data that may contradict it.
- ICT Literacy-Students can provide examples of how new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research, and how the very availability of new technology itself often sparks scientific advances.
- Life and Career Skills-Students can describe and provide examples of how people may be impacted positively or negatively by the outcomes of scientific studies, technical developments, and scientific approaches applied to real world problems; Students recognize the role of science

in society and can identify potential sources of bias and influence that can affect scientific research and the use and reporting of scientific information.

Unit 2 Motion in Two Dimensions

5 Weeks

Unit 2 Overview

In this unit, students will understand how to resolve a two-dimensional vector into its components. Students will solve two-dimensional motion problems with and without constant acceleration, or projectile motion.

Essential Questions

- How does a stream of water get narrower as it falls from a faucet?
- If there is no air resistance, how and why would it be dangerous to go outdoors on a rainy days?

Essential Learning Outcomes

- Students will understand how to resolve a two-dimensional vector into its components.
- Students will solve two-dimensional motion problems with and without constant acceleration, or projectile motion.

Technology Infusion

8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

Standards Addressed

S-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-PS2-2	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.
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.
PS3.A PS3.B	Identify and quantify the various types of energies within a system of objects in a well-defined state, such as elastic potential energy, gravitational potential energy, kinetic energy, and thermal energy and represent how these energies may change over

	time
PS3.A	Calculate changes in kinetic energy and gravitational potential energy of a system using representations of that system
HS PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
HS PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-PS2-4	Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects

Differentiation

Learning Activity	Students Who Need More Support	Enrichment
Labs	➢ Assigned Role ➢ Frequent Check ins ➢ Heterogenous learnings levels within lab group ➢ Smaller group sizes ➢ Confirm understanding of lab procedure ➢ Lab instructions with visual support ➢ Pre- teach essential laboratory vocabulary ➢ Provided a graphic organizer of graphing procedure ➢ Teach self-regulation strategies	➢ Students should be asking their own questions ➢ Students should be designing their own experiments ➢ Students create questions for further investigation and study ➢ Students reflect on redesign of their experiment ➢ Students research and connect the lab experiment to a current science industry practices and real life applications
Blended Learning Rotational Model	➢ Differentiated small group instruction ➢ Differentiated formative assessment ➢ One-to-one computer based instruction/assessment ➢ Manipulative stations: visual support, kinesthetic learning, hands-on learning ➢ Differentiated reading and writing station (graphic organizers and brainstorming activities) ➢ Provide student leaders within each group ➢ Written directions at each station ➢ Teach self-regulation strategies	
Whole	➢ Provide guided notes	➢ Ask higher level, open ended questions

Group Instruction	➢ Provide visual and auditory support ➢ Frequent check ins/close proximity monitoring ➢ Interactive lecture (question and answer for formative assessment and discussion) ➢ Summarize key points ➢ Introduce new vocabulary concepts before the lesson	throughout lecture ➢ Asks students to make connections to current science industry practices and real life applications ➢ Ask student to prepare or lead a science lecture or learning activity ➢ Ask students to summarize key points/concepts

Assessments

- Laboratory Report,
- Lab Research Presentation
- Quizzes
- Exams
- PowerPoints Presentations
- Research Simulation Task
- Debate
- Problem Based Learning Activity Presentations
- Night Write

21st Century Learning Connection

- Creativity and Innovation-Students explain how scientific understanding builds on itself over time, and how advancements in science depend on creative thinking based on the knowledge and innovations of others.
- Critical Thinking and Problem Solving-Students understand that scientific research and experimentation are guided by fundamental concepts, and that investigations are conducted for different reasons, such as exploring new phenomena, building on previous results, comparing different theories, and addressing problems facing society.
- Communication and Collaboration-Students model the practices of research science by informing others about their work, developing effective explanations, constructing and defending reasoned arguments, and responding appropriately to critical comments about their explanations. Students can explain why mathematical equations and formulae are used as representations of scientific phenomena and as a means of communicating scientific ideas. Students collaborate with peers and experts during scientific discourse and appropriately defend arguments using scientific reasoning, logic, and modeling.
- Information Literacy-Students are able to determine the verifiability of evidence presented in print and electronic resources to evaluate scientific claims.
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- ICT Literacy-Students can provide examples of how new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research, and how the very availability of new technology itself often sparks scientific advances.
- Life and Career Skills-Students can describe and provide examples of how people may be impacted positively or negatively by the outcomes of scientific studies, technical developments, and scientific approaches applied to real world problems; Students recognize the role of science in society and can identify potential sources of bias and influence that can affect scientific research and the use and reporting of scientific information.

Unit 3 – Forces and Newton's Law

5 Weeks

Unit 3 Overview

In this unit, students will be able to tell the difference between inertial and gravitational mass and weight. Students will study force in this lesson by listing examples of forces, such as friction, and describing how forces on everyday objects can be measured. Students will learn how to calculate the resultant force given component forces. Students must be able to determine and describe the conditions that are necessary for an object to stay at rest or at a constant velocity.

Students will be able to create a free-body diagram for an object, and then use it to calculate the net force on the object. Students will explore Newton's first law, which teaches students how to apply the concept of inertia to explain relevant physical phenomena. Students will move on to Newton's second law, which teaches them how to apply Newton's second law to qualitatively explain the effect of force on motion and how to solve one-dimensional motion problems. Students will conclude the lesson with Newton's third law, which requires them to compare action and reaction forces. Students must then explain the affects of action and reaction forces on a pair of objects.

Essential Questions

- How do you determine which team wins the tug-of-war: the team that pulls harder on the rope or the team that pushes harder on the ground? Explain.
- A baseball bat is swung against a baseball, which accelerates. When the ball is caught, how is the force produced on the player's glove?

Essential Learning Outcomes

- Students will be able to tell the difference between inertial and gravitational mass and weight.
- Students will study force in this lesson by listing examples of forces, such as friction, and describing how forces on everyday objects can be measured.
- Students will learn how to calculate the resultant force given component forces.
- Students must be able to determine and describe the conditions that are necessary for an object to stay at rest or at a constant velocity.
- Students will be able to create a free-body diagram for an object, and then use it to calculate the net force on the object.
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Differentiation

Learning Activity	Students Who Need More Support	Enrichment
Labs	➢ Assigned Role ➢ Frequent Check ins	➢ Students should be asking their own questions

	➢ Heterogenous learnings levels within lab group ➢ Smaller group sizes ➢ Confirm understanding of lab procedure ➢ Lab instructions with visual support ➢ Pre- teach essential laboratory vocabulary ➢ Provided a graphic organizer of graphing procedure ➢ Teach self-regulation strategies	➢ Students should be designing their own experiments ➢ Students create questions for further investigation and study ➢ Students reflect on redesign of their experiment ➢ Students research and connect the lab experiment to a current science industry practices and real life applications
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Whole Group Instruction	➢ Provide guided notes ➢ Provide visual and auditory support ➢ Frequent check ins/close proximity monitoring ➢ Interactive lecture (question and answer for formative assessment and discussion) ➢ Summarize key points ➢ Introduce new vocabulary concepts before the lesson	➢ Ask higher level, open ended questions throughout lecture ➢ Asks students to make connections to current science industry practices and real life applications ➢ Ask student to prepare or lead a science lecture or learning activity ➢ Ask students to summarize key points/concepts

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Unit 4 – Momentum and Mechanical Energy

7 Weeks

Unit 4 Overview

Students will understand when given an object's mass and velocity and required to calculate its momentum. Students must put their trigonometry and vector analysis to work in order to solve momentum problems. Students will understand how to apply the relationship between impulse and momentum in order to perform an analysis of changes in momentum. Students will learn how to apply conservation of momentum to qualitative analysis of systems of objects. Students finish the lesson by applying conservation of momentum in analyzing and calculating the momentum of objects in a system. Students will describe and identify examples of energy, relate work to energy, and solve problems using the formula "work equals force times distance." Students will understand how to measure power and then solve power problems with the formula P=W/t. Students will explore how to identify potential energy, as well as how to calculate the gravitational potential energy of an object near earth's surface using the formula PE=mgh. Students will identify kinetic energy, as well as how to calculate translational kinetic energy using the formula "kinetic energy equals one half the mass times velocity squared."

Students will learn how to analyze a physical system in order to identify energy transfers from one form to another. Students will demonstrate conservation of energy in an isolated system, and then compare isolated systems with systems that are not isolated. Students will study machines in this lesson so that they can understand the amount of work, power, and total energy that is required by the machine in order for it to work.

Students will calculate the efficiency of simple machines and engines.

Essential Questions

- In a movie, the hero jumps straight down from a bridge onto a small boat that continues to move with no change in velocity. How is physics being violated here?
- You jump from canoe to the nearby dock, expecting an easy landing. Instead, you land in the water. How and why does this take place?

Essential Learning Outcomes

- Students will understand when given an object's mass and velocity and required to calculate its momentum.
- Students must put their trigonometry and vector analysis to work in order to solve momentum problems. Students will understand how to apply the relationship between impulse and momentum in order to perform an analysis of changes in momentum.
- Students will learn how to apply conservation of momentum to qualitative analysis of systems of objects. Students finish the lesson by applying conservation of momentum in analyzing and calculating the momentum of objects in a system.
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	➢ Teach self-regulation strategies	
Whole Group Instruction	➢ Provide guided notes ➢ Provide visual and auditory support ➢ Frequent check ins/close proximity monitoring ➢ Interactive lecture (question and answer for formative assessment and discussion) ➢ Summarize key points ➢ Introduce new vocabulary concepts before the lesson	➢ Ask higher level, open ended questions throughout lecture ➢ Asks students to make connections to current science industry practices and real life applications ➢ Ask student to prepare or lead a science lecture or learning activity ➢ Ask students to summarize key points/concepts

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Unit 5 – Gravity Motion and Gravitation

5 Weeks

Unit 5 Overview

In this unit, students will explore the difference between rotation, revolution, and uniform circular motion. Students will be able to measure and calculate the force necessary to create the uniform circular motion of an object. Students are taught how to describe the effects of changing mass or distance on gravitational force. Students must also spend time investigating gravitational forces. Students learn how to calculate the magnitude of a gravitational force when the masses and distance are given. Students will be able to describe and draw the gravitational field around a mass. Students will learn how to explain the relationship between gravity and weight, and how to predict weight based on gravity. Students will explore and discover Kepler's laws and orbital motion.

Essential Questions

- If a trapeze artist rotates once each second while sailing through the air and contracts to reduce her rotational inertia to one-third of what it was, how many rotations per second will result?
- If you hang at rest by your hand from a vertical rope, where is your center of gravity with respect to the rope and how will you avoid injury while on the rope?

Essential Learning Outcomes

- Students will explore the difference between rotation, revolution, and uniform circular motion. Students will be able to measure and calculate the force necessary to create the uniform circular motion of an object.
- Students are taught how to describe the effects of changing mass or distance on gravitational force. Students must also spend time investigating gravitational forces.
- Students learn how to calculate the magnitude of a gravitational force when the masses and distance are given.
- Students will be able to describe and draw the gravitational field around a mass.
- Students will learn how to explain the relationship between gravity and weight, and how to predict weight based on gravity.
- Students will explore and discover Kepler's laws and orbital motion.

Technology Infusion

8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
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Standards Addressed

S-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-PS2-2	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.
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.
PS3.A PS3.B	Identify and quantify the various types of energies within a system of objects in a well-defined state, such as elastic potential energy, gravitational potential energy, kinetic energy, and thermal energy and represent how these energies may change over time
PS3.A	Calculate changes in kinetic energy and gravitational potential energy of a system using representations of that system
HS PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
HS PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-PS2-4	Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects

Differentiation

Learning Activity	Students Who Need More Support	Enrichment
Labs	➢ Assigned Role ➢ Frequent Check ins ➢ Heterogenous learnings levels within lab group ➢ Smaller group sizes ➢ Confirm understanding of lab procedure ➢ Lab instructions with visual support ➢ Pre- teach essential laboratory vocabulary ➢ Provided a graphic organizer of	➢ Students should be asking their own questions ➢ Students should be designing their own experiments ➢ Students create questions for further investigation and study ➢ Students reflect on redesign of their experiment ➢ Students research and connect the lab experiment to a current science industry practices and real life

	graphing procedure ➢ Teach self-regulation strategies	applications
Blended Learning Rotational Model	➢ Differentiated small group instruction ➢ Differentiated formative assessment ➢ One-to-one computer based instruction/assessment ➢ Manipulative stations: visual support, kinesthetic learning, hands-on learning ➢ Differentiated reading and writing station (graphic organizers and brainstorming activities) ➢ Provide student leaders within each group ➢ Written directions at each station ➢ Teach self-regulation strategies	
Whole Group Instruction	➢ Provide guided notes ➢ Provide visual and auditory support ➢ Frequent check ins/close proximity monitoring ➢ Interactive lecture (question and answer for formative assessment and discussion) ➢ Summarize key points ➢ Introduce new vocabulary concepts before the lesson	➢ Ask higher level, open ended questions throughout lecture ➢ Asks students to make connections to current science industry practices and real life applications ➢ Ask student to prepare or lead a science lecture or learning activity ➢ Ask students to summarize key points/concepts

Assessments

- Laboratory Report,
- Lab Research Presentation
- Quizzes
- Exams
- PowerPoints Presentations
- Research Simulation Task
- Debate
- Problem Based Learning Activity Presentations
- Night Write

21st Century Learning Connection

- Creativity and Innovation-Students explain how scientific understanding builds on itself over time, and how advancements in science depend on creative thinking based on the knowledge and innovations of others.
- Critical Thinking and Problem Solving-Students understand that scientific research and experimentation are guided by fundamental concepts, and that investigations are conducted for different reasons, such as exploring new phenomena, building on previous results, comparing different theories, and addressing problems facing society.
- Communication and Collaboration-Students model the practices of research science by informing others about their work, developing effective explanations, constructing and defending reasoned arguments, and responding appropriately to critical comments about their explanations. Students can explain why mathematical equations and formulae are used as representations of scientific phenomena and as a means of communicating scientific ideas.

Students collaborate with peers and experts during scientific discourse and appropriately defend arguments using scientific reasoning, logic, and modeling.

- Information Literacy-Students are able to determine the verifiability of evidence presented in print and electronic resources to evaluate scientific claims.
- Media Literacy-Students are able to critique claims that people make when they select only data that support the claim, and ignore data that may contradict it.
- ICT Literacy-Students can provide examples of how new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research, and how the very availability of new technology itself often sparks scientific advances.
- Life and Career Skills-Students can describe and provide examples of how people may be impacted positively or negatively by the outcomes of scientific studies, technical developments, and scientific approaches applied to real world problems; Students recognize the role of science in society and can identify potential sources of bias and influence that can affect scientific research and the use and reporting of scientific information.

Unit 6 – Waves, Heat, and Energy

5 Weeks

Unit 6 Overview

Students will explore simple harmonic motion, and then be required to explain it based on observations of springs and on Hooke's law. Students will discover about the properties of waves, which includes wavelength, frequency, period, speed, and amplitude. Students must then use this information to solve a variety of problems. Students will discuss the difference between transverse and longitudinal waves. Students will explore their understanding of the transfer of energy by waves. Students will describe the Doppler effect. Students will study temperature as it relates to the particles that make up an object. Students will explore heat as it relates to the internal energy of an object. Students must then compare and contrast what they have learned about temperature and heat. Students will discover heat transfer and its forms: conduction, convection, and radiation. Students will apply kinetic-molecular theory when comparing phase changes, and how to describe the change in heat energy associated with a phase change.

Essential Questions

- A grandfather pendulum clock keeps perfect time. Then it is relocated to a summer home high in the mountains. How does it run, slower, or the same? Explain.
- A heavy person and a light person swing to and fro on swings of the same length. How would you determine who has the longest period?

Essential Learning Outcomes

- Students will explore simple harmonic motion, and then be required to explain it based on observations of springs and on Hooke's law.
- Students will discover about the properties of waves, which includes wavelength, frequency, period, speed, and amplitude.
- Students must then use this information to solve a variety of problems.
- Students will discuss the difference between transverse and longitudinal waves. Students will explore their understanding of the transfer of energy by waves.
- Students will describe the Doppler effect. Students will study temperature as it relates to the particles that make up an object.

- Students will explore heat as it relates to the internal energy of an object. Students must then compare and contrast what they have learned about temperature and heat.
- Students will discover heat transfer and its forms: conduction, convection, and radiation.
- Students will apply kinetic-molecular theory when comparing phase changes, and how to describe the change in heat energy associated with a phase change.

Technology Infusion

8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

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