Willingboro
Public Schools

"Where Excellence is the Expectation"

Physics

Revised: November 2022
Supervisor: Jennifer Brandon

From New Jersey Student Learning Standards

Course Sequence/Table of Contents:

1	• Forces • Motion
2	• Conservation of Energy and Momentum • Electromagnetism
3	• Waves • Heat and Thermodynamics
4	• Properties of Matter • Chemical Reactions

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Overview	Content Standards	Core Ideas
Unit 1	● 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. ● HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. ● HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements. ● 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-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). ● 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-PS2-2 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.	● Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. ● Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. ● Newton's second law accurately predicts changes in the motion of macroscopic objects. ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This

Overview	Content Standards	Core Ideas
		last concept includes radiation, a phenomenon in which energy stored in fields moves across space.
Unit 2	● HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. ● HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). ● HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. ● 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-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-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-PS2-5 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. ● 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.	● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the

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Overview	Content Standards	Core Ideas
	• HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. • HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	extent possible and stated in such a way that one can tell if a given design meets them. (secondary) • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. • When two objects interacting through a field change relative position, the energy stored in the field is changed. • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.

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Overview	Content Standards	Core Ideas
		• Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system. • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
Unit 3	• HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. • HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • 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-PS4-2 Evaluate questions about the advantages of using a digital transmission and storage of information. • 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-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-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior	• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.

Overview	Content Standards	Core Ideas
	and wave interactions with matter to transmit and capture information and energy. ● HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. ● 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-PS2-2 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-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. ● Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary) ● Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. ● Photoelectric materials emit electrons when they absorb light of a high-enough frequency. ● Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. ● Newton's second law accurately predicts changes in the motion of macroscopic objects.

Overview	Content Standards	Core Ideas
		● Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. ● If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. ●
Unit 4	● HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. ● HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ● HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. ● HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those

Overview	Content Standards	Core Ideas
	• HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. • HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. • HS-PS1-4 Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. • HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. • HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary) • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. • A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. • Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions

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<table>
<tr><th>Overview</th><th>Content Standards</th><th>Core Ideas</th></tr>
<tr><td></td><td></td><td>of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary)</td></tr>
<tr><td>Suggested Open Educational Resources</td><td colspan="2">20 SEL Activities for High School (SEL)
Crash Course Physics Videos
Physics — bozemanscience
PhET Physics Simulations
Influential Black Physicists (Amistad Law)
The Great Escape: Nine Jews Who Fled Hitler (Holocaust Law)
LGBT Physicists Face Discrimination, Exclusion, Intimidation & how to create more inclusive workplaces (LGBTQ+)
Climate change is physics (Climate Change)
What Are the Physics of Global Warming? (Climate Change)
Making diversity, equity, inclusion integral part of physics education (Diversity, Equity, Inclusion)
Making Physics More Inclusive (Diversity, Equity, Inclusion)</td></tr>
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Unit 1

- Forces
- Motion

Overview

The Physics curriculum is designed to continue student investigations of the physical sciences that began in grades K-8 and provide students the necessary skills to recognize its relationship with the other sciences. The physics curriculum includes interactions of matter and energy, velocity, accelerations, force, energy, momentum and charge. Students will be challenged to apply their knowledge of the laws of physics to solve physics related critical thinking problems.

Essential Questions	Enduring Understandings
• How do electromagnetism and gravitation differ from the strong and weak nuclear forces? • What evidence is there that gravity affects Earth and the sun? • What forces hold an atom together, and how are those forces involved in nuclear reactions? • What is Coulomb's Law? • How do centripetal force, acceleration, and velocity come together in circular motion? • How do you solve work and power problems? • Why is the total velocity of a roller coaster zero at the end of the ride? How does its speed vary with its location? • How can Newton's laws of motion and the law of gravitation predict the motion of an object, and how can frames of reference be used to describe that motion? • How can the motion of objects be explained in terms of the balanced and unbalanced forces acting upon them? • What is the relationship between force and motion? • When a baseball bat hits a baseball, the force of the bat causes the ball to change velocity, but what happens to the bat? • How do Newton's three laws of motion explain the movement of people and objects around you? • How do free body diagrams allow you to predict an object's change in motion? • How do the displacement, velocity, and acceleration of a runner change as he races from the starting line toward the finish line?	• Gravity is universal and ALL objects attract each other with a force of gravitational attraction. This is dependent upon the masses of both objects and inversely proportional to the square of the distance that separates their centers. • Coulomb's Law explains how strong the force will be between two electrostatic charges. The magnitude, or strength, of the Coulomb force is proportional to the size of each charge and inversely proportional to the square of the distance between them. • A non-contact force is a type of force that acts on the object, without any physical contact; e.g. electrostatic force, gravitational force, and magnetism. • Newton's three laws of motion can be used to accurately model the motion of macroscopic objects. • Motion is relative and can be described using position, velocity, acceleration and time. • Force affects the state of motion; e.g. it can cause motion to happen or it can cause it to stop. • Free-body diagrams are diagrams used to show the relative magnitude and direction of all forces acting upon an object in a given situation.

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Unit 1

Performance Expectations

- 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.
- HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
- HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- 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-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).
- 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-PS2-2 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.

Core Ideas

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
- Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
- Newton's second law accurately predicts changes in the motion of macroscopic objects.
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Student Learning Objectives

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Students will be able to: ● Define gravitational force and explain how it impacts objects ● Predict how electrostatic forces will impact objects ● Explain the relationship between the Sun and the orbiting planets around the Sun ● Compare and contrast motors and generators ● Plan and conduct investigations and apply scientific ideas to make sense of Newton's law of gravitation and Coulomb's Law ● Construct an explanation of a model of electric charge, and make a qualitative prediction about the distribution of positive and negative electric charges within neutral systems as they undergo various processes ● Understand Newton's Law of Universal Gravitation ● Understand that the motion of an object in orbit is under the influence of gravitational forces ● Determine the force that one spherically symmetrical mass exerts on another. ● Determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass ● Recognize that the motion does not depend on the object's mass ● Describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend upon the radius of the orbit ● Derive expressions for the velocity and period of revolution in such an orbit. ● Predict an object's position/ speed and motion through graphical analysis. ● Explain a force diagram and how the forces interact

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
● Utilize modifications & accommodations delineated in the student's IEP ● Provide additional manipulatives to support instruction ● Allow for alternative strategies to solve algorithms or tasks ● Provide the steps needed to complete the task ● Model frequently ● Provide repetition and practice. ● Use visuals to demonstrate/model the processes ● Restate, reread, and clarify directions/questions ● Ask students to restate information, directions, and assignments. ● Provide copy of class notes ● Distribute study guide for classroom tests. ● Provide preferential seating to be mutually determined by the student and teacher ● Provide extra textbooks for home.	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors ● Modify Assignments ● Use testing and portfolio assessment ● Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) ● Repeat, rephrase, paraphrase key concepts and directions ● Allow for extended time for assignment completion as needed ● Highlight key vocabulary ● Define essential vocabulary in context ● Use graphic organizers, visuals, manipulatives and other concrete materials ● Use gestures, facial expressions and body language ● Read aloud	● Pair visual prompts with verbal presentations ● Ask students to restate information, directions, and assignments. ● Provide repetition and and practice ● Model skills / techniques to be mastered. ● Provide extended time to complete class work ● Provide copy of class notes ● Provide preferential seating to be mutually determined by the student and teacher ● Allow the use of a computer to complete assignments. ● Establish expectations for correct spelling on assignments ● Provide extra textbooks for home. ● Provide Peer Support ● Increase one on one time

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• Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	• Build on what students already know and prior experience	

Gifted and Talented Students	504 Plan
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments

Interdisciplinary Connections	Computer Science and Design Thinking
Math • A-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. • F-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. • F-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. • F-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. • A-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. **English Language Arts** Reading	**Computer Science and Design Thinking Practices** 1. ☐ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. ☐ Recognizing and Defining Computational Problems 4. ☐ Developing and Using Abstractions 5. ☐ Creating Computational Artifacts 6. ☐ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards**

● RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing ● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ● WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. ● WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. ● WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. ● WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	● 8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. ● 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources. **Core Ideas** ● Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information. ● The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data. ● The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices
- Act as a responsible and contributing community member and employee.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.

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- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

Formative Assessment Plan	Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards. Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods: • Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) • Exit tickets, rotational activities (stations), quizzes, and small group activities • Classwork, homework, group work • Pre-Assessments, teacher's observation, class discussion, and journal • Journal Writing • Daily Verbal Assessments • Sharing Ideas; providing students' feedback • Discussions • Quizzes • Personal Progress Checks • Think-Pair-Share • Simulations	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.* • **Multiple Choice and Free Response Assessments** • **Lab Investigations** • **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module test or constructed responses) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Acceleration, Acceleration Due to Gravity, Energy, Force, Frictional Force, Impulse, Kinematics, Law of Conservation of Momentum, Mass, Mechanical Energy, Momentum, Motion, Net Force, Newton, System, Thermal Energy, Vector Quantity, Velocity, Balanced Force, Macroscopic, Mass, Newton, Newton's Second Law of Motion, Speed, Unbalanced Force, Vector Quantity, Velocity, Charge, Coulomb's Law, Electric Field, Electrical Force, Electrostatic Force, Field Forces, Gravitation, Gravitational Field, Gravitational Force, Newton's Law of Universal Gravitation, Attractive Force Orbital Velocity, Kepler's Law, Orbital Radius, Weight

Resources

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- Teachable Moment: Newton's First Law | Fast Forward | PBS LearningMedia
- Health Effects of Zero Gravity | PBS LearningMedia **(Amistad Law)**
- Your Weight on Other Worlds | PBS LearningMedia
- Unit 3, Segment F: Gravity | Physics in Motion | PBS LearningMedia
- Black Hole Apocalypse | How to Detect Gravitational Waves | PBS LearningMedia
- Newton's Law of Universal Gravitation
- Phet Simulations
  - PhET: Simulation Practice - Charges and Fields
  - PhET: Simulation Practice - Coulomb's Law
  - PhET: Simulation Practice - Gravity Force Lab

Pacing Guide
Can be found within the textbook.

Unit 2

- Conservation of Energy and Momentum
- Electromagnetism

Overview

The Physics curriculum is designed to continue student investigations of the physical sciences that began in grades K-8 and provide students the necessary skills to recognize its relationship with the other sciences. The physics curriculum includes interactions of matter and energy, velocity, accelerations, force, energy, momentum and charge. Students will be challenged to apply their knowledge of the laws of physics to solve physics related critical thinking problems.

Essential Questions	Enduring Understandings
• What steps are involved in converting potential energy to kinetic energy, or kinetic energy to potential energy? • How is energy transferred between objects or systems? • How does the momentum of a soccer ball change as it travels from player to player? • What is the relationship between temperature, pressure, and energy transfer when popping popcorn? • As you push a heavy box up a ramp, what forces do work on the box? • What is the cause/effect relationship between electric and magnetic fields? • How have electric and magnetic forces shaped the world in which we live? • What happens when an electric charge moves through a circuit? • How does the structure of a material explain its behavior as a conductor or an insulator?	• Energy can be stored, transferred, and transformed, but cannot be created or destroyed. • Momentum can be defined as "mass in motion" and is contingent upon mass and velocity. • The change in momentum of a body due to the force acting on it is called impulse; it can be calculated by multiplying the average value of a force and the time during which it acts. • Total momentum of a system of objects is conserved when there is no net external force on the system. • Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. • Fields contain energy that depends on the arrangement of the objects in the field. • When two objects interacting through a field change relative position, the energy stored in the field is changed.

Unit 2

Performance Expectations

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, eliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).
- HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- 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-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-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-PS2-5 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.
- 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.
- HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
- HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Core Ideas

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.
- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.
- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary)

Unit 2

Performance Expectations

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.
- When two objects interacting through a field change relative position, the energy stored in the field is changed.
- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy.
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency.
- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.
- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
- The availability of energy limits what can occur in any system.
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

Student Learning Objectives

Students will be able to:

- Calculate kinetic and potential energy
- Manipulate variables that affect kinetic and potential energy (e.g. mass, velocity, height)
- Identify various ways that energy is transferred within systems and objects
- Calculating elastic and inelastic collisions in the physical world and the associated graphical representations to predict/prove their motion.
- Apply the concepts of momentum and Newton's Laws to real-world examples
- Describe how energy is conserved by identifying various types of energies in a system
- Illustrate how electric currents produce magnetic fields
- Explain how a changing magnetic field produces an electric current
- Create an electric current flow through hands-on inquiry
- Identify characteristics of insulators and conductors

Integrated Accommodations and Modifications

Special Education Students	English Language Learners	At Risk
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	504 Plan
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments
Interdisciplinary Connections	**Computer Science and Design Thinking**

Math ● HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **English Language Arts** Reading ● RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing ● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ● WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. ● WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	**Computer Science and Design Thinking Practices** 1. ☐ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. ☐ Recognizing and Defining Computational Problems 4. ☐ Developing and Using Abstractions 5. ☐ Creating Computational Artifacts 6. ☐ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** ● 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. ● 8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **Core Ideas** ● Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. ● Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
Career Readiness, Life Literacies and Key Skills	

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Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards. Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods: ● Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) ● Exit tickets, rotational activities (stations), quizzes, and small group activities ● Classwork, homework, group work ● Pre-Assessments, teacher's observation, class discussion, and journal ● Journal Writing ● Daily Verbal Assessments ● Sharing Ideas; providing students' feedback ● Discussions	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.* ● **Multiple Choice and Free Response Assessments** ● **Lab Investigations** ● **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module test or constructed responses) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

• Quizzes • Personal Progress Checks • Think-Pair-Share • Simulations • Debates	
Targeted Academic Vocabulary	
Energy, Conservation, Energy Transformation, Kinetic Energy, Elastic/Gravitational Potential Energy, Work, Power, Momentum, Impulse, Collisions (Elastic/Inelastic), Electromagnetic Induction, Electromagnetic Radiation, Electromagnetism, Magnetic Field, Repulsion, Volt, Voltage, Alternating Current (AC), Ampere, Circuit, Conductor, Current, Direct Current, Work	

Resources
• The Physics Classroom: Work and Energy • Energy is Everything: Interactive Lesson | UNC-TV Science | PBS LearningMedia • Unit 4, Segment B: Conservation of Momentum | Physics in Motion | PBS LearningMedia • Demonstration of Momentum, Resistivity and Frequency | PBS LearningMedia • PBS: Electricity & Magnetism
Pacing Guide
Can be found within the textbook.

Unit 3

- Waves
- Heat and Thermodynamics

Overview	
The Physics curriculum is designed to continue student investigations of the physical sciences that began in grades K-8 and provide students the necessary skills to recognize its relationship with the other sciences. The physics curriculum includes interactions of matter and energy, velocity, accelerations, force, energy, momentum and charge. Students will be challenged to apply their knowledge of the laws of physics to solve physics related critical thinking problems.	
Essential Questions	**Enduring Understandings**
• How do you know that the waves sent from the sun to Earth are not mechanical waves? • How does light from a headlamp use a lens and a mirror to produce a narrow beam? • How do the position, velocity, and acceleration of a child on a swing change as they oscillate back and forth? • What is heat, how is it related to temperature and thermal energy, and how does the transfer of thermal energy affect matter?	• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. • The wavelength and frequency of a wave is related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. • Waves can be reflected, refracted, absorbed, diffracted, or scattered depending on the surface it interacts with.

• In terms of the particles involved, how do changes in temperature, pressure, and volume affect a gas? • What factors affect the efficiency of a heat engine? • How do the laws of thermodynamics determine the function and efficiency of various technology systems? • How does the second law of thermodynamics predict the increasing entropy of a system?	• All matter is composed of particles which have a certain amount of energy which allows them to move at different speeds depending on the temperature (energy). • Energy is transferred spontaneously from a higher temperature system to a lower temperature system; this process is called heat. • There are four laws of thermodynamics; discussing temperature, heat, work, and entropy. • The first law of thermodynamics states that the total energy of an isolated system is constant; energy can be transformed from one form to another, but can be neither created nor destroyed. • The second law of thermodynamics indicates that entropy is real. It states that, in an isolated system, entropy can increase but cannot decrease.

Unit 3

Performance Expectations

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- 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-PS4-2 Evaluate questions about the advantages of using a digital transmission and storage of information.
- 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-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-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
- HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
- 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-PS2-2 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-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Core Ideas

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

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Unit 3

Performance Expectations

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.
- Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.
- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency.
- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
- Newton's second law accurately predicts changes in the motion of macroscopic objects.
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).
- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.

Student Learning Objectives

Students will be able to:

- Explain how waves behave in different types of matter
- Describe the relationship between wavelength, velocity, frequency and energy

- Identify and define the different wave models
- Explore the ways that energy moves through and interacts with its surroundings
- Compare heat, thermal energy, and temperature
- Illustrate how particles change when temperature, volume, or pressure are adjusted
- Explain how some energy is always converted to thermal energy, to overcome the friction of machines
- Apply the Laws of Thermodynamics to real-world scenarios

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	**504 Plan**
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work

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● Allow for a variety in types of resources ● Provide problem-based assignments with planned scope and sequence ● Utilize inquiry-based instruction ● Adjust the pace of lessons ● Utilize Choice Boards ● Provide Problem-Based Learning ● Establish flexible Grouping	● Provide copy of class notes ● Break long assignments into smaller parts ● Assist student in setting short term goals ● Allow for preferential seating to be mutually determined by the student and teacher ● Provide extra textbooks for home. ● Model and reinforce organizational systems (i.e. color-coding) ● Write out homework assignments, check student's recording of assignments
Interdisciplinary Connections	**Computer Science and Design Thinking**
Math ● HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **English Language Arts** Reading ● RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing ● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ● WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. ● WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. ● WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas,	**Computer Science and Design Thinking Practices** 1. ☐ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. ☐ Recognizing and Defining Computational Problems 4. ☐ Developing and Using Abstractions 5. ☐ Creating Computational Artifacts 6. ☐ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** ● 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. ● 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources. ● 8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. **Core Ideas** ● The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities. ● Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information. ● The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.

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avoiding plagiarism and overreliance on any one source and following a standard format for citation. ● WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards. Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods:	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.* ● **Multiple Choice and Free Response Assessments** ● **Lab Investigations**

• Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) • Exit tickets, rotational activities (stations), quizzes, and small group activities • Classwork, homework, group work • Pre-Assessments, teacher's observation, class discussion, and journal • Journal Writing • Daily Verbal Assessments • Sharing Ideas; providing students' feedback • Discussions • Quizzes • Personal Progress Checks • Think-Pair-Share • Simulations • Graphing Activities	• **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module test or constructed responses) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Amplitude, Compression or Longitudinal Wave, Constructive Interference, Crest, Destructive Interference, Electromagnetic Spectrum, Frequency, Infrared Radiation, Interference, Medium, Rarefaction, Resonance, Speed, Transverse Wave, Trough, Velocity, Wave, Wavelength, Thermodynamic, Laws of Thermodynamics, Entropy, Coolant, Heat, Thermal Energy, Temperature

- The Anatomy of a Wave
- Teach Engineering: Electromagnetic Waves
- Physics for Kids: Waves
- Phet Simulations:
  - PhET: Simulation Practice - Wave Interference
  - PhET: Simulation Practice - Wave on a String
- Equilibrium and Advanced Thermodynamics | Chemistry: Unit 9 | PBS LearningMedia
- Newsela - The transfer of thermal energy can occur in three ways
- Thermodynamics and Enthalpy | Chemistry: Unit 7 | PBS LearningMedia
- Unit 12, Segment H: Chemical Thermodynamics Review | Chemistry Matters | PBS LearningMedia
- Thermodynamics | Crash Course Physics | PBS LearningMedia

Pacing Guide

Can be found within the textbook.

Unit 4

- Properties of Matter
- Chemical Reactions

Overview

The Physics curriculum is designed to continue student investigations of the physical sciences that began in grades K-8 and provide students the necessary skills to recognize its relationship with the other sciences. The physics curriculum includes interactions of matter and energy, velocity, accelerations, force, energy, momentum and charge. Students will be challenged to apply their knowledge of the laws of physics to solve physics related critical thinking problems.

Essential Questions	Enduring Understandings
• How is the periodic table's arrangement related to the chemical properties of the elements? • Why are atoms considered the basic building blocks of all matter? • How do the nuclei of radioactive elements break down, and how can we make use of the process? • How does matter change during a chemical reaction, and how is energy involved in these changes?	• A chemical property is a characteristic of a substance that may be observed when it participates in a chemical reaction; e.g. flammability, toxicity, chemical stability, and heat of combustion. • Atomic energy is the source of power for both nuclear reactors and nuclear weapons. This energy comes from the splitting (fission) or joining (fusion) of atoms. • As the nucleus emits radiation or disintegrates, the radioactive atom (radionuclide) transforms to a different nuclide; this process is called radioactive decay. • During a chemical reaction, thermal energy can either be released or absorbed resulting in a temperature change.

Unit 4

Performance Expectations

- HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- HS-PS1-4 Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Core Ideas

Unit 4

Performance Expectations

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary)
- Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary)

Student Learning Objectives

Students will be able to:

- Classify and discuss various elements on the Periodic Table of Elements
- Explain how the Periodic Table of Elements is organized
- Describe the structure of atoms and how molecules can form when atoms join
- Identify the various types of radiations
- Determine how elements break down and assess ways to utilize this process

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- Outline the process of radioactive decay and how atoms within an element change
- Detect whether or not a chemical reaction took place by presenting various pieces of data; e.g. temperature change, formation of a precipitate, etc.

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	**504 Plan**

● Utilize advanced, accelerated, or compacted content ● Provide assignments that emphasize higher- level thinking skills. ● Allow for individual student interest ● Gear assignments to development in areas of affect, creativity, cognition, and research skills ● Allow for a variety in types of resources ● Provide problem-based assignments with planned scope and sequence ● Utilize inquiry-based instruction ● Adjust the pace of lessons ● Utilize Choice Boards ● Provide Problem-Based Learning ● Establish flexible Grouping	● Pair visual prompts with verbal presentations ● Ask students to restate information, directions, and assignments. ● Provide repetition and and practice ● Model skills / techniques to be mastered. ● Provide extended time to complete class work ● Provide copy of class notes ● Break long assignments into smaller parts ● Assist student in setting short term goals ● Allow for preferential seating to be mutually determined by the student and teacher ● Provide extra textbooks for home. ● Model and reinforce organizational systems (i.e. color-coding) ● Write out homework assignments, check student's recording of assignments
Interdisciplinary Connections	**Computer Science and Design Thinking**
Math ● A-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. ● F-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. ● F-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. ● F-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. ● A-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. **English/Language Arts** Reading ● RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing ● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	**Computer Science and Design Thinking Practices** 1. □ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. □ Recognizing and Defining Computational Problems 4. □ Developing and Using Abstractions 5. □ Creating Computational Artifacts 6. □ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** ● 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. ● 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. ● 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources. **Core Ideas** ● Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to

• WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	influence how other people interpret and understand the underlying information. • Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information. • The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data. • The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.

Career Readiness, Life Literacies and Key Skills
Career Readiness, Life Literacies and Key Skills Practices • Act as a responsible and contributing community members and employee • Consider the environmental, social and economic impacts of decisions. • Demonstrate creativity and innovation. • Utilize critical thinking to make sense of problems and persevere in solving them. • Use technology to enhance productivity increase collaboration and communicate effectively. • Work productively in teams while using cultural/global competence. • 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). • 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). • 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1) • 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). • 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). • 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a). • 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection. • 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3). • 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.

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- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2)
- 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards. Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods: • Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) • Exit tickets, rotational activities (stations), quizzes, and small group activities • Classwork, homework, group work • Pre-Assessments, teacher's observation, class discussion, and journal • Journal Writing • Daily Verbal Assessments	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.* • **Final Projects** • **Research Report** • **Presentations** • **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Matter, Element, Periodic Table of Elements, Periods, Families/Groups, Reactivity, Valence Electrons, Catalyst, Chemical equilibrium, Chemical reaction, Endothermic, Exothermic, Forward reaction, Ions, Pressure, Product(s), Reactant(s), Reverse Reaction, Oxidation, Single Replacement Reaction, Double Replacement Reaction

Resources

- Exploring the Periodic Table | PBS LearningMedia
- Unit 10, Segment A: Chemical Equilibrium | Chemistry Matters
- The Delicate Balance of Chemical Reactions | Chemistry: Unit 9
- PhET Simulation - Atomic Interaction

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• Types of Chemical Reactions - Video • Chemical Reactions Unit
Pacing Guide
Can be found within the textbook.