Integrated Science Curriculum

Grade Level(s): 9

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Course Description: This course is designed to serve as a foundation for other high school science courses. It will emphasize the basic laws of chemistry, environmental science and physics. Laboratory and problem solving activities will be utilized to cover the curriculum. This course will include the following units:

- Scientific Inquiry
- Structure and Properties of Atoms/Matter
- Forces and Interactions/Electricity and Magnetism
- Nature and Properties of Mechanical and Electromagnetic Waves
- Nature, Conservation, and Transfer of Energy
- Weather/Climate and Human Sustainability
- History of the Earth
- Space Systems

Year At A Glance			
Unit Title	**Overarching Essential Question**	**Overarching Enduring Understanding**	**Vision of A Learner "I Can" Statements**
Scientific Inquiry (5 weeks)	How do scientists collect and analyze data?	All scientists collect data accurately and communicate that accuracy through data tables and graphs.	TI1(9-12); TCC3(9-12)
Structure and Properties of Atoms/Matter (5 weeks)	How do scientists explain the structure and properties of atoms and matter?	The periodic table can be used to make predictions about the properties of elements and compounds.	TCC2(9-12); TI3(9-12)
Forces and Interactions/ Electricity and Magnetism (9 weeks)	How do scientists explain and predict interactions between objects and within a system of objects?	Newton's Second Law and Coulomb's Law describe and predict the gravitational and electrostatic forces between objects.	TI3(9-12)
Nature and Properties of Mechanical and Electromagnetic Waves (2 weeks)	How are waves used to transfer energy and send and store information?	Combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information.	TI3(9-12); TCC2(9-12)
Nature, Conservation, and Transfer of Energy (3 1/2 weeks)	How is energy transferred and conserved?	Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system, and the total change of energy in any system is always equal to the total energy transferred into or out of the system.	AA3(9-12)

Weather/Climate and Human Sustainability (5 weeks)	How do humans depend on the Earth's resources?	Human and system interactions control weather and climate.	TCC2(9-12); CCE4(9-12)
History of the Earth (3 weeks)	How do people reconstruct and date events in Earth's planetary history?	A key to Earth's history is the coevolution of the biosphere with Earth's other systems, not only in the ways that climate and environmental changes have shaped the course of evolution but September 2017 ©2013 Achieve, Inc. All rights reserved. 89 of 102 also in how emerging life forms have been responsible for changing Earth.	TCC2(9-12); CCE3(9-12)
Space Systems (3 weeks)	What is the Universe and what goes on in Stars?	Our world formed during the Big Bang and within the cores of stars.	TCC1(9-12); CCE1(9-12); DE4(9-12); TI2(9-12); AA1(9-12)

Unit 1 - Scientific Inquiry

Desired Results - Students will collect accurate data and communicate that data effectively.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

HSN-Q.A.1 - Use units as a way to understand 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.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

NGSS Standards:

HS-PS2-6 - Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.
- TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings:

- Students will understand that scientists take accurate data and communicate the accuracy of that data through graphs and how that data is written.

Essential Questions:

- How do scientists collect data?
- How do scientists communicate their data?
- How do scientists graph data?

Students will know…

- The accuracy of all measuring devices available in a science classroom.
- The difference between independent and dependent variables.
- Appropriate units for scientific data

Students will be able to...

- Use equipment in a science classroom correctly and accurately.
- Differentiate between independent and dependent variables.
- Identify appropriate controls and constants in an experiment.
- Put numbers in and out of scientific notation
- Perform basic metric conversions.
- Graph data appropriately.

Key Vocabulary: balance, graduated cylinder, ruler, length, mass, volume, temperature, accuracy, precision, scientific notation, independent variable, dependent variable, control, hypothesis, metric conversions, direct relationship, indirect/inverse relationship

Assessment Evidence

Performance Tasks:

- Build a Car
- Measurement Activity
- Will it float experiment?
- Measuring the density of Solids

Other Evidence:

- Graphing activities
- Scientific Notation practice
- Metric Conversion Practice
- Unit 1 Test

Learning Plan

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

- Build a car out of common school supply materials and analyze the effectiveness of designs using distance data
- Use mass and volume data to determine why substances sink or float
- Use mass and volume data to determine the density of substances

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

- Write laboratory procedures
- Write conclusions based on analysis of data

HSN-Q.A.1 - Use units as a way to understand 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

- Graphically use mass and volume data to determine the density of substance
- Accurately measure objects and choose appropriate units
- Use scientific notation to accurately display data
- Use metric conversions appropriate to the size and quantity of data

HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

- Write data consistent with the accuracy of the measuring device

HS-PS2-6 - Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials

- Correlate mass and volume data to a substance's density

VOL Common Assessments:
THINK CRITICALLY AND CREATIVELY
TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

- Build a car and make it roll

TAKE INITIATIVE

TI (9-12) Can implement a realistic plan and adapt when necessary to achieve my goals.

- Build a car and make it roll

Teacher Resources:

Physical Science: Concepts in Action Chapter 1

Unit 2 - Structure and Properties of Atoms/Matter

Desired Results - Students will use the periodic table to predict properties of elements and their resulting compounds.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

HSN-Q.A.1 - Use units as a way to understand 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.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

NGSS Standards:

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-PS2-6 - Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

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-PS1-7 - Use mathematical representations to support claims that atoms, and therefore mass are conserved during a chemical reaction.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- TI3(9-12): I can formulate and investigate probing questions to further my learning.

Understandings: Students will understand that...	**Essential Questions:**
• 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. • Elements combine to form compounds so that their valence	• How do scientists explain the structure and properties of matter? • How does an elements' position on the periodic table relate to its properties? • How does the combination of elements relate to the properties of the resulting compound?

shells are complete. ● The properties of compounds are related to the types of elements that combine to make them. ● 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	
Students will know… ● The position and amount of protons, neutrons and electrons in an atom ● The basic structure and group names of the periodic table ● Mass is conserved during a chemical reaction.	**Students will be able to…** ● Predict the properties and structure of an element based on its position on the periodic table ● Predict the properties of a compound based on its composition ● Predict the formula of a compound based on its composition ● Balance a chemical equation
Key Vocabulary: proton, neutron, electron, element, compound, mass number, atomic number, charge, ionic, covalent, metal, nonmetal, metalloid, halogen, alkali metal, alkali earth metal, transition metal, noble gas, octet rule, valence shell, law of conservation of mass, chemical reaction	
Assessment Evidence	
Performance Tasks: Metals, Nonmetals, Metalloids Lab Start Zinc Chloride Lab Ionic compounds activity Building Covalent Compounds Activity Physical Science Lab Manual Investigation 6B Physical Science Lab Manual Investigation 7B	**Other Evidence:** Build an atom pHet simulation Atomic structure practice Periodic Table Basics Periodic Table Coloring 2021.doc - Google Drive Review Atomic Structure/Periodic Table Balancing Equations Practice Balancing Equations Game Unit 2 Test
Learning Plan	
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words ● Translate chemical names into balanced chemical equations	

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

- Write laboratory procedures
- Write conclusions based on analysis of data

HSN-Q.A.1 - Use units as a way to understand 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

- Use the amount of protons, neutrons and electrons to determine an element's mass and charge
- Use mass data to prove mass is conserved during a chemical reaction

HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

- Use mass data to prove mass is conserved during a chemical reaction
- Use mass data to predict the formula of a compound

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.

- Use an atoms position of the periodic table to predict the type and formulas of a compound (both ionic and covalent)

HS-PS2-6 - Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

- Use the chemical formulas of compounds to make predictions about their properties
- Use the properties of compounds to make predictions about their chemical formulas

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.

- Use the octet rule to make predictions about the formulas of compounds
- Predict the number of valence electrons based on an element's position on the periodic table
- Make predictions about an element’s properties based on its position on the periodic table.

HS-PS1-7 - Use mathematical representations to support claims that atoms, and therefore mass are conserved during a chemical reaction.

- React copper to prove mass is conserved during a chemical reaction
- React zinc and hydrochloric acid to prove mass is conserved during a chemical reaction

VOL Common Assessments:
THINK CRITICALLY AND CREATIVELY
TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Metals, nonmetals, metalloids lab
- Zinc chloride lab
- Recognizing a Synthesis Reactions lab

TAKE INITIATIVE
TI3(9-12): I can formulate and investigate probing questions to further my learning.

- Comparing Ionic and Molecular Compounds Lab

Teacher Resources:
Physical Science: Concepts in Action Chapters 2 -7
Physical Science Lab Manual Investigation 6B
Physical Science Lab Manual Investigation 7B

Unit 3 - Forces and Interactions/Electricity and Magnetism

Desired Results - Students will use Newton's Second Law and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
HSN-Q.A.1 - Use units as a way to understand 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.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

NGSS Standards:

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-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-PS2-5 - Plan and conduct an investigation to pro
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.vide evidence that an electric current can produce a magnetic field and that changing a magnetic field can produce an electric current.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TI3(9-12): I can formulate and investigate probing questions to further my learning.

Understandings: Students will understand that…

- The total momentum of a system of objects is conserved when there is no net force on the system.
- Newton's second law accurately predicts changes in the motion of macroscopic objects.

Essential Questions:

- How can one explain and predict interactions between objects and within a system of objects?
- What is Newton's Second law?
- Why are some materials attracted to each other while others are

• 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. • 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.	not? • Why do some objects keep moving? • Why do some objects fall to the ground?
Students will know... • Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. • 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. • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.	**Students will be able to...** • use Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. • apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
Key Vocabulary: distance/time graph, acceleration, velocity, speed, circuit, parallel circuit, series circuit, transformer, motor, Ohm's law, power, circuit breaker, fuse, static electricity, magnet, poles, electromagnet, current, resistance, voltage, wattage	
Assessment Evidence	
Performance Tasks: • Acceleration in Lab Chairs • Speed and Velocity Lab - Funny Walk • Graph Matching Lab • Balloon Lab • Circuit Challenge • Ohm's Law Lab • Static Electricity lab • Electromagnet Lab • Motor Lab	**Other Evidence:** • Distance, time, speed practice problems • Motion Graphs Worksheets • Speed of Different Objects • Forces and Motion Test • Circuit Builder Gizmo • Ohm's law worksheet • Power calculation worksheet • Static Electricity Simulation • Electricity Test • Activity 7-2 (magnetic fields) • Activity 7-3 (electromagnets)

	• Electricity/Magnetism Test

Learning Plan

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
- Use position/time graphs to explain motion, speed and acceleration
- Use circuit diagrams to explain the flow of electricity

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- Write laboratory procedures
- Write conclusions based on analysis of data

HSN-Q.A.1 - Use units as a way to understand 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.
- Use Ohm's law to calculate voltage, current and resistance
- Calculate the power generating or used in a circuit

HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Measure position and time to calculate speed
- Use an Ammeter to analyze circuits

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.
- Analyze position, time and speed data

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.
- Analyze position, time and speed data

HS-PS2-3 - Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- Analyze position, time and speed data

HS-PS2-5 - Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that changing a magnetic field can produce an electric current.
- Use magnetic field and electrical current to produce a motor

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.
- Use magnetic field and electrical current to produce a motor

VOL Common Assessments:
TAKE INITIATIVE

TI3(9-12): I can formulate and investigate probing questions to further my learning.

- Acceleration in Lab Chairs Lab
- Speed of Different Objects Lab
- Balloon Lab
- Electromagnet Lab
- Motor Lab

Teacher Resources:
Physical Science: Concepts in Action Chapters 11 - 12 and 19 - 20

Unit 4 - Nature and Properties of Mechanical and Electromagnetic Waves

Desired Results - Students will understand that combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
HSN-Q.A.1 - Use units as a way to understand 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.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

NGSS Standards:

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.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TI3(9-12): I can formulate and investigate probing questions to further my learning.
- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

Understandings: Students will understand that…	**Essential Questions:**
● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on	● How are waves used to transfer energy and send and store information?

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. ● 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. ● 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.	● How are frequency, wavelength and energy of waves related?
Students will know… ● 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. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) ● 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. ● Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	**Students will be able to…** ● Calculate energy, frequency and wavelength. ● Explain how a telescope works. ● Explain the practical applications of sound and electromagnetic radiation.
Key Vocabulary: transverse waves, longitudinal waves, mechanical waves, sound, electromagnetic radiation, reflection, refraction, frequency, wavelength, Planck's constant, energy, amplitude, photoelectric effect	
Assessment Evidence	
Performance Tasks:	**Other Evidence:**

• Sound waves lab • Waves poster	• Waves Webquest • Reflection/Refraction • pHet simulation • Wave Calculations - sound, Wave calculations - light

Learning Plan

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
- Use graphical analysis to determine the frequency, wavelength and amplitude of waves.

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- Write laboratory procedures
- Write conclusions based on analysis of data

HSN-Q.A.1 - Use units as a way to understand 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.
- Calculate wavelength, frequency and energy.

HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Measure wavelength and amplitude

HS-PS4-1 - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
- Calculate wavelength, frequency and energy.

HS-PS4-2 - Evaluate questions about the advantages of using a digital transmission and storage of information.
- Investigate the properties and uses of waves

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.
- Investigate practical applications of waves

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.
- Investigate how computers and our cell phones use waves to store information

VOL Common Assessments:
TAKE INITIATIVE
TI3(9-12): I can formulate and investigate probing questions to further my learning.
- Sound Waves Lab

THINK CRITICALLY AND CREATIVELY
TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Waves Poster

Teacher Resources:
Physical Science: Concepts in Action Chapters 17 + 18

Unit 5 - Nature, Conservation, and Transfer of Energy

Desired Results - Students will understand that energy is understood as a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system, and the total change of energy in any system is always equal to the total energy transferred into or out of the system.

Established Goals:
Common Core State Standards:
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
HSN-Q.A.1 - Use units as a way to understand 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.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
NGSS Standards:
HS-PS2-4 - Use mathematical representations of Newton's Second Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS3-1 - Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2 - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position 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.

<table>
<tr><td colspan="2">Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

● AA3(9-12): I can adjust my expectations and behaviors to succeed in a changing and unpredictable environment.</td></tr>
<tr><td>Understandings: Students will understand that…
● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
● 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.
● The availability of energy limits what can occur in any system.
● 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).
● When two objects interacting through a field change relative position, the energy stored in the field is changed.</td><td>Essential Questions:
● How is energy transferred and conserved?</td></tr>
<tr><td>Students will know…
● 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.
● 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</td><td>Students will be able to...
● Calculate potential and kinetic energy.
● Graphically analyze the potential and kinetic energy of an object in motion.</td></tr>
</table>

fields moves across space. ● 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.	
Key Vocabulary: kinetic energy, gravitational potential energy, elastic potential energy, gravity	
Assessment Evidence	
Performance Tasks: ● Marble Launcher Lab ● Elastic PE Lab ● Roller coaster Project ● Stair climbing power lab ● Kinetic Energy and Potential Energy Test	**Other Evidence:** ● Skate Park Simulation ● Guided Reading Questions ● KE and PE calculations ● Roller coaster Physics Gizmo
Learning Plan	
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words. ● Use graphical analysis to determine the frequency, wavelength and amplitude of waves. RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. ● Write laboratory procedures ● Write conclusions based on analysis of data HSN-Q.A.1 - Use units as a way to understand 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. ● Calculate kinetic and potential energy HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ● Measure height, mass and velocity to calculate potential and kinetic energy HS-PS2-4 - Use mathematical representations of Newton's Second Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. ● Calculate potential and kinetic energy of systems 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. ● Design a rollercoaster that converts potential energy directly to kinetic energy	

HS-PS3-2 - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

- Calculate the potential and kinetic energy of an object based on its position

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.

- Design a rollercoaster that converts potential energy directly to kinetic energy

VOL Common Assessments:
ADAPT AND ADJUST:
AA3(9-12): I can adjust my expectations and behaviors to succeed in a changing and unpredictable environment.

- Roller Coaster Project

Teacher Resources:
Physical Science: Concepts in Action Chapter 15

Unit 6 - Weather/Climate and Human Sustainability

Desired Results - Students will understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

NGSS Standards:

HS-ESS2-4 - Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS3-5 - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
HS-ESS3-1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-ESS3-6 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings: Students will understand that...	**Essential Questions:**
● The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. ● Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. ● Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gasses added to the atmosphere each year and by the ways in which these gasses are absorbed by the ocean and biosphere. ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.	● What regulates weather and climate? ● How do humans depend on Earth's resources? ● How do people model and predict the effects of human activities on Earth's climate?
Students will know…	**Students will be able to...**
● Solar cells are human-made devices that capture the sun's energy and produce electrical energy. ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the	● Discuss the pros and cons of various sources of energy production. ● Create a plan of action to combat climate change.

earth. These phenomena cause a cycle of ice ages and other gradual climate changes. ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ● Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.	
Key Vocabulary: atmosphere, troposphere, stratosphere, mesosphere, thermosphere, ionosphere, ozone layer, climate, global warming	
Assessment Evidence	
Performance Tasks: ● Exploration Lab: Determining Relative Humidity ● Investigation 24B: Modeling Global Warming ● Investigating Energy Sources ● Acid Rain Lab ● Create a climate change awareness project ● Climate change/weather test	**Other Evidence:** ● Textbook assessment questions ● Greenhouse Gizmo simulation ● Climate change article ● What is acid rain? Article and questions ● Acid rain/global warming/ozone depletion
Learning Plan	
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words. ● Use graphical analysis to determine weather patterns RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. ● Analysis multiple sources of climate change data RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. ● Create a climate change awareness project ● Write conclusions based on analysis of data	

HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

- Analyze the effects of climate change

HS-ESS2-4 - Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

- Analyze global temperature data as an indicator of climate change

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

- Analyze carbon cycles in nature

HS-ESS3-5 - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS-ESS3-1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

- Research energy resources and their production of carbon dioxide

HS-ESS3-2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

- Investigate the pros and cons of various sources of energy production

HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

- Investigate carbon, sulfur and water cycles to understand their relationship with biodiversity

HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

- Create an action plan to combat climate change

HS-ESS3-6 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

- Create a poster indicating how humans are impacting the climate along with an action plan to combat those negative effects.

VOL Common Assessments:
THINK CRITICALLY AND CREATIVELY
TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Investigating Energy Sources Project

COLLABORATE AND COMMUNICATE EFFECTIVELY
CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

- Climate Change Awareness Project

Teacher Resources:

Physical Science: Concepts in Action Chapter 24

Unit 7 - History of the Earth

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

NGSS Standards:

HS-ESS1-5 - Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS1-6 - Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- CCE3(9-12): I can show initiative in prompting group discourse and fostering collaboration among others, providing actionable feedback, and working with others to solve problems and/or design products.

Understandings: Students will understand that…	**Essential Questions:**

• Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. • Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	• How do people reconstruct and date events in Earth's planetary history? • Why do the continents move? • How do the major Earth systems interact? • How do the properties and movements of water shape Earth's surface and affect its systems?
Students will know… • Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. • Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. • Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. • The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. • The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large	**Students will be able to...** • Identify different types of rocks and predict where/how they were formed. • Read/develop a contour map • Explain the movement of continents and ocean plates

amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks	

Key Vocabulary: geologist, crust, mantle, lithosphere, asthenosphere, mesosphere, core, fracture, cleavage, streak, luster, hardness, igneous, magma, lava, sedimentary, metamorphic, rock cycle, plate tectonics, pangea, continental drift, mid ocean ridge, sea-floor spreading, subduction, divergent boundary, convergent boundary, transform boundary, earthquake, seismic waves, fault, epicenter, volcano, deposition, glacier, fossil

Assessment Evidence

Performance Tasks:

- Investigation 22A: Identifying Rocks
- Investigation 22B: Recovering Oil
- Investigation 23A: Using a Contour Map to Create a Landform
- History of the Earth Unit Test

Other Evidence:

- Textbook associated worksheets, reading guides and end of section questions

Learning Plan

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.

- Review data to construct a contour map

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Write conclusions based on analysis of data

HS-ESS1-5 - Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

- Investigate the movement of continents and the ocean plates

HS-ESS1-6 - Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

- Investigate the history of the Earth

HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

- Investigate the movement of continents and the ocean plates

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

- Investigate the interior of the Earth

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

- Investigate the rock cycle and various types of rocks

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

- Investigate the history of the Earth

VOL Common Assessments:
THINK CRITICALLY AND CREATIVELY
TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Identifying Types of Rocks Lab

COLLABORATE AND COMMUNICATE EFFECTIVELY
CCE3(9-12): I can show initiative in prompting group discourse and fostering collaboration among others, providing actionable feedback, and working with others to solve problems and/or design products.

- Recovering Oil Lab
- Deflecting an Asteroid Lab

Teacher Resources:
Physical Science: Concepts in Action Chapters 22 + 23

Unit 8 - Space Systems

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:
Common Core State Standards:
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
NGSS Standards:
HS-ESS1-1 - Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
HS-ESS1-2 - Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3 - Communicate scientific ideas about the way stars, over their life cycle, produce elements.
HS-ESS1-4 - Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.
- CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.
- DE4(9-12): I can work respectfully with all members of my community and support the needs of others.
- TI2(9-12): I can evaluate my objectives and a variety of credible resources to find the best solutions for any challenge.
- AA1(9-12): I can evaluate different approaches and justify the best pathway to success.

Understandings: Students will understand that...

- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gasses, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.

Essential Questions:

- What is the universe, and what goes on in stars?
- What are the predictable patterns caused by Earth's movement in the solar system?

Students will know...

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.
- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or

Students will be able to…

- Construct a model of the solar system
- Predict the elements present in stars

collisions with, other objects in the solar system. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	

Key Vocabulary: meteoroids, tides, terrestrial planets, asteroids, asteroid belt, gas giants, Kuiper belt, Oort cloud, solar nebula, protoplanetary disk, planetesimals, accretion, core, radiation zone, convection zone, photosphere, chromosphere, corona, solar wind, sunspot, prominences, solar flare, absorption lines, light year, nebula, supernova, neutron star, black hole, big bang theory, Hubble's Law, parallax

Assessment Evidence

Performance Tasks:	Other Evidence:
● Investigation 25A: Deflecting an Asteroid ● Exploration Lab: Modeling the Solar System ● Exploration Lab: Investigating Parallax	● Textbook associated worksheets, reading guides and end of section questions

Learning Plan

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
- Use data to predict the distance of nearby stars

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- Write conclusions based on analysis of data

HS-ESS1-1 - Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
- Investigate the origin of stars and their composition

HS-ESS1-2 - Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
- Use the Big Bang Theory to analyze the origin of the universe

HS-ESS1-3 - Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- Use emission spectra to analyze the composition of stars

HS-ESS1-4 - Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
- Use data to predict the distance of nearby stars

VOL Common Assessments:

THINK CRITICALLY AND CREATIVELY
TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

- Deflecting an Asteroid Lab

COLLABORATE AND COMMUNICATE EFFECTIVELY
CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.

- Modeling the Solar System Lab

DEMONSTRATE EMPATHY
DE4(9-12): I can work respectfully with all members of my community and support the needs of others.

- Work collaboratively with classmates during laboratory assignments throughout the school-year

TAKE INITIATIVE
TI2(9-12): I can evaluate my objectives and a variety of credible resources to find the best solutions for any challenge.

- Investigating Parallax

ADAPT AND ADJUST
AA1(9-12): I can evaluate different approaches and justify the best pathway to success.

- Deflecting an Asteroid Lab

Teacher Resources:
Physical Science: Concepts in Action Chapters 24 + 25