Perris Union High School District
Course of Study

A. COURSE INFORMATION

Course Title:

Science 9

- ❑ New
- ✓ Revised

If revised previous course name if changed

Transcript Course Code/Number:

(To be assigned by Educational Services)

Subject Area:

- ❑ Social Science
- ❑ English
- ❑ Mathematics
- ✓ Laboratory Science
- ❑ World Languages
- ❑ Visual or Performing Arts
- ❑ College Prep Elective
- ❑ Other

Is this classified as a Career Technical Education course?

- ❑ Yes
- ✓ No

Grade Level

- ❑ MS
- ❑ HS
- ❑ 5
- ❑ 6
- ❑ 7
- ❑ 8
- ✓ 9
- ❑ 10
- ❑ 11
- ❑ 12

Required for Graduation:

- ✓ Yes
- ❑ No

Credential Required to teach this course:

Single Subject: Science: Geosciences; Science: Physics

To be completed by Human Resources only.

Signature: [signature] Date: 12/10/2019

Meets UC/CSU Requirements?

- ✓ Yes
- o No

Was this course *previously approved by UC* for PUHSD?

- ❑ Yes
- ✓ No

(Will be verified by Ed Services)

Meets "Honors" Requirements?

- ❑ Yes
- ✓ No

Meets "AP" Requirements?

- ❑ Yes
- ✓ No

Unit Value/Length of Course:

- ❑ 0.5 (half year or semester equivalent)
- ✓ 1.0 (one year equivalent)
- ❑ 2.0 (two year equivalent)
- ❑ Other:

Submitted by: Gretchen Schultz
Site: SSC
Date: 12/05/2019

Approvals	Name/Signature	Date
Director of Curriculum & Instruction	[signature]	12-11-19
Asst. Superintendent of Educational Services	[signature]	12-12-19
Governing Board		

Prerequisite(s) (REQUIRED):

None

Corequisite(s) (REQUIRED):

Algebra 1 or above

Brief Course Description (REQUIRED):

This course teaches students the basic principles of Physics and Earth/Space science through experimentation and engineering practices designed for introductory level, conceptual physics. Classic science principles of forces, motion, waves, energy conversion, and nuclear processes will be explored through both Earth and space science phenomena as well as classical and modern physics principles. Students will continue to develop their skills of reading, writing, discussion, and analysis through lab reports, investigations, and group presentations. There will be a strong emphasis on investigations and engineering solutions to both problems in the class and problems in the larger world. This course will introduce students to basic physics concepts that are fundamental for understanding science and will cover NGSS Performance Expectations from the domains of Physical Science, Earth Space Science, and Engineering, Technology, & Applications of Science.

B. COURSE CONTENT

Course Purpose (REQUIRED):
What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. Note: More specificity than a simple recitation of the State Standards is needed.

In order to achieve the NGSS goal of 'All Standards, All Students' through implementation of the California Science Framework High School Three Course Model with Earth Science standards embedded in biology, chemistry, and physics courses, we must expand our science curriculum to make physics accessible to all students. This introductory course is aligned with the California Next Generation Science Standards and addresses the standards of the Physics in the Universe course at an introductory, conceptual level. The Science 9 course will meet the requirements of a D approved course and allow students to complete the physical science graduation requirement for PUHSD, as well as achieve college and career readiness through through building scientific and mathematical reasoning skills within the context of physics and earth science topics. This course will prepare students for more advanced physical science and biology courses by providing a foundation for understanding general scientific principles and practices present in all levels of science coursework.

Course Outline (REQUIRED):
Detailed description of topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered.

INSTRUCTIONAL SEGMENT 1: FORCES AND MOTION (Semester 1 - Week 1-8)
Summary: Students will learn how to describe and explain the motion of an object so that students can improve their explanations of nature and our universe.

Guiding Questions:
-How can Newton's laws be used to explain how and why things move?
-How can mathematical models of Newton's Laws be used to test and improve engineering design?

Disciplinary Core Ideas:
PS2.A: Forces and Motion

- 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.

ETS1.A: Defining and Delimiting an Engineering Problem

- 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.

ETS1.C: Optimizing the Design Solution

- 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 (tradeoffs) may be needed.

Engineering & Lab Activities/Performance Tasks

- Common Activities:
  - Motion Graphs
- Examples
  PS 2-1
  - Tug of War
  - A falling object
  - An object rolling down a ramp
  - Moving object being pulled by a constant force.

  - PS 2-2 (ntsa)
  - Bumper Improvement Crash Lab
  - 2-car collisions
  - Billiard spheres
  - Egg drop/collision

PS 2-3 (ntsa)
  - Collision barrier
  - Fortnight dilema
  - Newton's cradle
  - Golf ball collisions
  - Rube goldberg

- Extensions
  - Asteroid collision
  - Launch a ball using known force to travel with a certain acceleration
  - Click here
  - Wind Tunnel and Stability

INSTRUCTIONAL SEGMENT 2: ENERGY CONSERVATION & RENEWABLES

Summary: Students will learn principles of conservation of energy and momentum so that students can describe and explain collisions and energy transfers.

Guiding Questions:

- How do power plants generate electricity?
- What engineering designs can help increase the efficiency of electricity production and reduce the negative impacts of using fossil fuels?

Disciplinary Core Ideas:

PS3.A: Definitions of Energy

- 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.

PS3.B: Conservation of Energy and Energy Transfer

- 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.

- 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)

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment.

ESS3.A: Natural Resources

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

ETS1.B: Developing Possible Solutions

- 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. (secondary)

Engineering & Lab Activities/Performance Tasks

PS 3-1 (ntsa)

- Heated pool cover
- Bouncing ball energy pole vault energy transfer
- Springy pen
- Hot wheel stopping distance

PS 3-2 (ntsa)

- Bowling ball pendulum
- Mag-lev trains
- Solar balloon
- Energy Chart (matching)

PS 3-3(ntsa)

- Spring Launcher
- Calorimetry

PS 3-4 (ntsa)

- Entropy
- Temperature stabilization

ESS 3-2 (ntsa)

- Planetary human sustainability

Extensions

- Launch known mass using spring device, and measure resultant velocity for kinetic energy calculation - use to calculate coefficient of elasticity
- Use height of mass to calculate kinetic energy - velocity of the object at any point in descent

INSTRUCTIONAL SEGMENT 3: FORCES AT A DISTANCE

Guiding Questions:

- How can different objects interact when they are not even touching?
- How do interactions between matter at the microscopic scale affects the macroscopic properties of matter that we observe?
- How do satellites stay in orbit?

Disciplinary Core Ideas:

PS2.B Types of Interactions

- 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

PS3.A: Definitions of Energy

- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed.

Engineering & Lab Activities/Performance Tasks

PS 2-4 (ntsa)

- Static Balloons
- Charged balloons and running water

PS 2-5 (ntsa)

- Electromagnet
- Induced Voltage

PS 3.5 (ntsa)

- Candle powered car
- Play-dough circuits

INSTRUCTIONAL SEGMENT 4: WAVES & EMR

Guiding Questions:

- How do we know what is inside the Earth?
- Why do people get sunburned by UV light?
- How can we transmit information over wires and wirelessly?

Disciplinary Core Ideas:

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed.

PS3.D: Energy in Chemical Processes

- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary)

PS4.A: Wave Properties

- 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.

PS4.B: Electromagnetic Radiation

- 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

PS4.C: Information Technologies and Instrumentation

- 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.

Engineering & Lab Activities/Performance Tasks:

PS 3-5 (ntsa)

- Magnetic Cannon
- Magnetic (silly) Putty
- Gravity Light
- Programmable Magnet
- Limiting Reactants

PS 4-1 (ntsa)

- Trichroic Prism
- SONAR
- Ruben's Tube
- Recovery of sound from a pic

PS 4-2 (ntsa)

- Analog v Digital

PS 4-3 (ntsa)

- Photoelectric effect

PS 4-4 (ntsa)

- Electroscope
- Sunscreen

PS 4-5 (ntsa)

- Solar Car

INSTRUCTIONAL SEGMENT 5: NUCLEAR PROCESS

Guiding Questions:

- What does E=mc2 mean?
- What is ‘c’ in E=mc2 and what is its relationship to the other variables in the equation?
- How can we solve for ‘m’ in E=mc2?
- How do nuclear reactions illustrate conservation of energy and mass?
- How do we determine the age of rocks and other geologic features?

Disciplinary Core Ideas:

PS1.C: Nuclear Processes

- 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.

ESS1.C: The History of Planet Earth

- 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.

ESS2.A: Earth Materials and Systems

- Earth’s systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- 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. (ESS2.B Grade 8 GBE) (secondary)

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary)

Engineering & Lab Activities/Performance Tasks:

PS 1-8
Chernobyl or Springfield

ESS 1-5
Plate tectonics

ESS 1-6
How does Earth avoid

ESS 2-1
Cause/Effect earthquakes

INSTRUCTIONAL SEGMENT 6: STARS & THE ORIGIN OF THE UNIVERSE
Guiding Questions:
- How do we know what stars are made out of?
- What fuels our sun? Will it ever run out of fuel?
- Do other stars work the same way as our sun?
- How do patterns in motion of the stars tell us about the origin of our universe?

Disciplinary Core Idea:
ESS1.A: The Universe and Its Stars
- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.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 gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- 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.

ESS1.B: Earth and the Solar System
- 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 collisions with, other objects in the solar system.

PS3.D: Energy in Chemical Processes and Everyday Life
- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary)

PS4.B: Electromagnetic Radiation
- 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. (secondary)

Engineering & Lab Activities/Performance Tasks:
ESS1-1
Nuclear Fusion of the Sun
Life of a Star

ESS1-2
Big Bang Theory
Doppler Effect

ESS1-3
Stardust: The Formation of Elements

ESS1-4
Orbital Motions

Writing Assignments (REQUIRED): ***Give examples of the writing assignments and the use of critical analysis within the writing assignments.***
Students will be required to complete formal lab reports on selected labs, including procedural descriptions, analysis of data, and evaluation of how data supports or rejects a hypothesis. Claim, Evidence, Reasoning assignments will be completed in which students will make a claim from either a provided scientific article or from data/observations made in class, provide evidence in the form of textual evidence statements or specific data, and explain how the evidence statements or data support the original claim. - Example: Students observe a demo regarding forces and motion and write a CER using data from the demo - Example: Student design an investigation to test a hypothesis regarding plate movement and write a formal lab report to share their findings. - Example: Students read an article on climate change and sea level rise and write an evidence based response to a student driven question about the article.

INSTRUCTIONAL MATERIALS (REQUIRED)	
Textbook #1	
Title: OER Resources/CK12 Flexbooks Online (free)	Edition:
Author:	ISBN:
Publisher:	Publication Date:
Usage: ❑ Primary Text ❑ Read in entirety or near	
Textbook #2	
Title:	Edition:
Author:	ISBN:
Publisher:	Publication Date:
Usage: ❑ Primary Text ❑ Read in entirety or near	
Supplemental Instructional Materials *Please include online, and open source resources if any.*	
CK12.org Wonders of Science	

NSTA/CSTA pHET online simulations

Estimated costs for classroom materials and supplies (REQUIRED). ***Please describe in detail.*** If more space is needed than what is provided, please attach backup as applicable.	
Cost for class set of textbooks: $	Description of Additional Costs:
Additional costs:$	
Total cost per class set of instructional materials:	$0

Key Assignments (REQUIRED):

Please provide a detailed description of the Key Assignments including tests, and quizzes, which should incorporate not only short answers but essay questions also. How do assignments incorporate topics? Include all major assessments that students will be required to complete

End of unit tests will provide questions modeled after the CAST and with common questions shared by all district science teachers. Each unit will include one common 5E lesson/lab completed by all school sites and used for data analysis on how well students are learning the essential standards and performance expectations. Lessons will be phenomena based.

Forces and Motion Lab: 2 Car Collisions
Students clearly define the system of the two interacting objects that is represented mathematically, including boundaries and initial conditions.
Students identify and describe* the momentum of each object in the system as the product of its mass and its velocity, p = mv (p and v are restricted to one-dimensional vectors), using the mathematical representations.
Students identify the claim, indicating that the total momentum of a system of two interacting objects is constant if there is no net force on the system.
Mathematical modeling
Students use the mathematical representations to model and describe* the physical interaction of the two objects in terms of the change in the momentum of each object as a result of the interaction.
Students use the mathematical representations to model and describe* the total momentum of the system by calculating the vector sum of the momenta of the two objects in the system.
Analysis
Students use the analysis of the motion of the objects before the interaction to identify a system with essentially no net force on it.
Based on the analysis of the total momentum of the system, students support the claim that the momentum of the system is the same before and after the interaction between the objects in the system, so that momentum of the system is constant.
Students identify that the analysis of the momentum of each object in the system indicates that any change in momentum of one object is balanced by a change in the momentum of the other object, so that the total momentum is constant.

Renewable Energy Design Evaluation

Supported claims
Students describe the nature of the problem each design solution addresses.
Students identify the solution that has the most preferred cost-benefit ratios.
Identifying scientific evidence
Students identify evidence for the design solutions, including:
Societal needs for that energy or mineral resource;
The cost of extracting or developing the energy reserve or mineral resource;
The costs and benefits of the given design solutions; and
The feasibility, costs, and benefits of recycling or reusing the mineral resource, if applicable.
Evaluation and critique
Students evaluate the given design solutions, including:
The relative strengths of the given design solutions, based on associated economic, environmental, and geopolitical costs, risks, and benefits;
The reliability and validity of the evidence used to evaluate the design solutions; and
Constraints, including cost, safety, reliability, aesthetics, cultural effects environmental effects.
Reasoning/synthesis
Students use logical arguments based on their evaluation of the design solutions, costs and benefits, empirical evidence, and scientific ideas to support one design over the other(s) in their evaluation.
Students describe that a decision on the "best" solution may change over time as engineers and scientists work to increase the benefits of design solutions while decreasing costs and risks.

Waves & EMR - SONAR Investigation
Students use at least two different formats (e.g., oral, graphical, textual, and mathematical) to communicate technical information and ideas, including fully describing* at least two devices and the physical principles upon which the devices depend. One of the devices must depend on the photoelectric effect for its operation. Students cite the origin of the information as appropriate.
When describing how each device operates, students identify the wave behavior utilized by the device or the absorption of photons and production of electrons for devices that rely on the photoelectric effect, and qualitatively describe how the basic physics principles were utilized in the design through research and development to produce this functionality (e.g., absorbing electromagnetic energy and converting it to thermal energy to heat an object; using the photoelectric effect to produce an electric current).
For each device, students discuss the real-world problem it solves or need it addresses, and how civilization now depends on the device.
Students identify and communicate the cause and effect relationships that are used to produce the functionality of the device.

Origin of Earth Assignment

Students construct an account of Earth's formation and early history that includes that:
i. Earth formed along with the rest of the solar system 4.6 billion years ago.
ii. The early Earth was bombarded by impacts just as other objects in the solar system were bombarded.
iii. Erosion and plate tectonics on Earth have destroyed much of the evidence of this bombardment, explaining the relative scarcity of impact craters on Earth.

Students include and describe the following evidence in their explanatory account:
i. The age and composition of Earth's oldest rocks, lunar rocks, and meteorites as determined by radiometric dating;

ii. The composition of solar system objects;
iii. Observations of the size and distribution of impact craters on the surface of Earth and on the surfaces of solar system objects (e.g., the moon, Mercury, and Mars); and
iv. The activity of plate tectonic processes, such as volcanism, and surface processes, such as erosion, operating on Earth.

Students use reasoning to connect the evidence to construct the explanation of Earth's formation and early history, including that:
i. Radiometric ages of lunar rocks, meteorites and the oldest Earth rocks point to an origin of the solar system 4.6 billion years ago, with the creation of a solid Earth crust about 4.4 billion years ago.
ii. Other planetary surfaces and their patterns of impact cratering can be used to infer that Earth had many impact craters early in its history.
iii. The relative lack of impact craters and the age of most rocks on Earth compared to other bodies in the solar system can be attributed to processes such as volcanism, plate tectonics, and erosion that have reshaped Earth's surface, and that this is why most of Earth's rocks are much younger than Earth itself.

Modeling the Sun
Students use evidence to develop a model in which they identify and describe* the relevant components, including:
Hydrogen as the sun's fuel;
Helium and energy as the products of fusion processes in the sun; and
That the sun, like all stars, has a life span based primarily on its initial mass, and that the sun's lifespan is about 10 billion years.

In the model, students describe* relationships between the components, including a description* of the process of radiation, and how energy released by the sun reaches Earth's system.

Students use the model to predict how the relative proportions of hydrogen to helium change as the sun ages.
Students use the model to qualitatively describe* the scale of the energy released by the fusion process as being much larger than the scale of the energy released by chemical processes.
Students use the model to explicitly identify that chemical processes are unable to produce the amount of energy flowing out of the sun over long periods of time, thus requiring fusion processes as the mechanism for energy release in the sun.

Instructional Methods and/or Strategies (REQUIRED):

Please list specific instructional methods that will be use.

Instruction will be phenomena based and follow the NGSS recommended ABC (Activity Before Content) and CBV (Content Before Vocabulary) format. Students will be encouraged to engage in relevant phenomena to generate questions, collaborate in small and large groups, and investigate concepts in order to develop scientific skills. Instructional practices will move away from teacher directed lessons to student driven lessons.

The BSCS 5E Instructional Model will be used to design common lessons - this involves extended lessons with 5 main components - Engage (prior knowledge accessed and interest engaging phenomenon) , Explore (activity to facilitate conceptual change), Explain (students generate explanation of phenomenon), Elaborate (understanding challenged and deepened through new experiences), and Evaluation (self assessment of understanding).

Assessment Methods and/or Tools (REQUIRED):
Please list different methods of assessments that will be used.
Students will be assessed using laboratory investigations including experiments driven by student questions (inquiry based). Certain labs will require a formal lab write up in which experimental methods, analysis, and technical writing will be assessed, others will be assessment through group discussions and process questions. Formative assessment will be used throughout lessons with call and response, short quizzes, gallery walks, Socratic seminars, and warm up assignments. Summative assessment will be in the form of unit tests, presentations, and group projects.

COURSE PACING GUIDE AND OBJECTIVES (REQUIRED)				
Day(s)	**Objective**	**Standard(s)**	**Chapter(s)**	**Reference**
IS 1 Weeks 2-12	Students will learn how to describe and explain the motion of an object so that students can improve their explanations of nature and our universe. • Compare the symbols of motion to English equivalent. • Explore position, distance, displacement, speed, velocity, and acceleration. • Explore forces, free-body diagrams, and net forces. • Apply Newton's Laws of Motion to describe the forces acting on an object.	**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 science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object		

		during a collision.*		
IS 2 Weeks 13-16	Students will learn principles of conservation of energy and momentum so that students can describe and explain collisions and energy transfers. • Compare the symbols of momentum and energy to English equivalent. • Explore momentum and impulse. • Explore kinetic and potential energy transfers. • Apply energy and momentum concepts to choose future energy production processes.	**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 motion 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.* 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).		
IS 3 Weeks 20-23	Students will describe and apply forces at a distance such as gravity, electricity, and magnetism. • Use models and formulas to predict gravitational forces between objects • Investigate the relationship between electric current and magnetism • Describe cause and effect relationship between forces	**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-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-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.		
IS 4	Students evaluate information about	**HS-PS3-5.**		

Weeks 24-29	interactions between waves and matter with a focus on electromagnetic waves. • Provide evidence from a lab showing how waves travel differently through different materials. • Explain the differences between different kinds of electromagnetic radiation in terms of energy. • Evaluate the advantages of using digital transmission of data and information, and provide examples of this technology. • Evaluate claims, evidence and reasoning behind the idea that electromagnetic radiation can behave as both a wave and a particle, and say when each is useful depending on situation.	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-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-ESS1-5.** Evaluate evidence of the past and future movements of continental and oceanic crusts and the theory of plate tectonics to explain the ages of crustal rocks.		
IS 5 Weeks	Students understand and describe collisions in the Earth's crust and the relationship to forces.	**HS-ESS1-5.** Evaluate evidence		

30-32	Two of the four fundamental forces are introduced. Radiation and its use in determining the age of rocks as well as energy production are central to the segment. • Understand the internal structure of an atom and apply it to the process of decay. • Explain the similarities and differences between fission, fusion, and radioactive decay and provide examples of each. • Relate the difference in mass between reactants and products in nuclear processes to the energy produced according to E = mc2 • Recognize that plates exist in the earth's crust and move relative to one another. Friction between plates can be stored and lead to geological phenomenon such as earthquakes and volcanic activity.	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-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.		
IS 6 33-36	Students consider the origin of the universe and the composition of stars and planets. • Describe the life cycle of the Sun and build a model to show how the sun	**ESS1-1:** Develop a model based on evidence to illustrate the life		

	produces energy in its core. • Build a model for the origins of the universe using light spectra, motion of distance galaxies, and composition of matter present in the universe. • Explain what the doppler effect is in relation to the expansion of universe and the effects it has on light. • Explain how stars produce different elements over their life cycles and use the emission spectra to show this.	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. **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. **ESS1-3:** Communicate scientific ideas about the way stars, over their life cycle, produce elements. **ESS1-4:** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		

C. HONORS COURSES ONLY
Indicate how much this honors course is different from the standard course.

D. BACKGROUND INFORMATION
Context for course (optional)
History of Course Development (optional)