

# High School Integrated Science



## Prioritized Standards and Instructional Units 2021-2022

## Unit 1: Motion (4 weeks; 9 weeks)

### Essential Questions:

**Core Idea PS2: Motion and Stability: Forces and Interactions**

**How can one explain and predict interactions between objects and within systems of objects?**

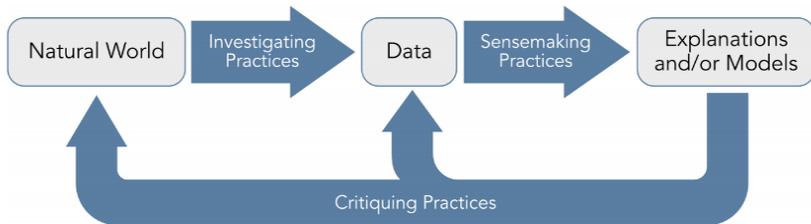
- How can one predict an object's continued motion, changes in motion, or stability?
- What underlying forces explain the variety of interactions observed?
- Why are some physical systems more stable than others?

**Core Idea ETS1: Engineering Design**

**How do engineers solve problems?**

- What is a design for? What are the criteria and constraints of a successful solution?
- What is the process for developing potential design solutions?
- How can the various proposed design solutions be compared and improved?

**Possible Phenomena: Coming Soon**



	Investigating Practices	Sensemaking Practices	Critiquing Practices
	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
Science Practices	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
	5. Using mathematical and computational thinking	6. Constructing explanations	

### 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.

**[Clarification Statement: Examples of evaluation and refinement could include determining the success of a device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]**

**Priority Standard**

### HS-PS2-1

**Priority Standard**

<p>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.</p> <p><b>[Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.]</b></p>	
<p style="text-align: center;"><b>HS-PS2-2</b></p> <p>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.</p> <p><b>[Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.]</b></p>	<p style="text-align: center;"><b>Priority Standard</b></p>

**Science and Engineering Practices:**

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**

Theories and laws provide explanations in science. (HS-PS2-1), (HS-PS2-4)

**Analyzing and Interpreting Data**

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution (HS-PS2-1)

**Using Mathematics and Computational Thinking**

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena to describe explanations. (HS-PS2-2)

**Crosscutting concepts:**

**Cause and Effect**

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects (HS-PS2-1)  
Systems can be designed to cause a desired effect. (HS-PS2-3)

**Systems and System Models**

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

**Disciplinary Core Ideas:****PS2.A: Forces and Motion**

Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

Newton's second law accurately predicts changes in the motion of macroscopic objects. 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.  
(HS-PS2-2),(HS-PS2-3)

**ETS1.A: Defining and Delimiting Engineering Problems**

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

**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. (secondary to HS-PS2-3)

## Unit 2: Energy (5 weeks; 9 weeks)

**Essential Questions:**

**Core Idea PS2: Motion and Stability: Forces and Interactions**

**How can one explain and predict interactions between objects and within systems of objects?**

- What underlying forces explain the variety of interactions observed?

**Core Idea PS3: Energy**

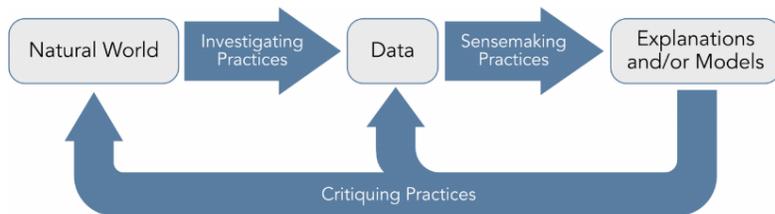
**How is energy transferred and conserved?**

- What is energy?
- What is meant by conservation of energy? How is energy transferred between objects or systems?
- How are forces related to energy?

**Core Idea PS4: Waves and their Applications in Technology for Information Transfer**

**How are waves used to transfer energy and information?**

**Possible Phenomena: Coming Soon**



	Investigating Practices	Sensemaking Practices	Critiquing Practices
	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
Science Practices	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
	5. Using mathematical and computational thinking	6. Constructing explanations	

**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.

**[Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.]**

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<p style="text-align: center;"><b>HS-PS3-5</b></p> <p>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.</p> <p><b>[Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.]</b></p>	<p><b>Priority Standard</b></p>
<p style="text-align: center;"><b>HS-PS3-2</b></p> <p>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).</p> <p><b>[Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]</b></p>	<p><b>Priority Standard</b></p>
<p style="text-align: center;"><b>HS-PS4-1</b></p> <p>Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <p><b>[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]</b></p>	<p><b>Supporting Standard</b></p>

**Science and Engineering Practices:**

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

(HS-PS2-5)

**Developing and Using Models**

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3- 2),(HSPS3-5)

**Using Mathematics and Computational Thinking**

Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

**Crosscutting concepts:**

**Cause and Effect**

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2- 1),(HS-PS2-5) (HS-PS4-1)

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

**Energy and Matter**

Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

**Disciplinary Core Ideas:**

**PS2.B: Types of Interactions**

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. (HS-PS2-4),(HS-PS2-5)

**PS3.A: Definitions of Energy**

...and “electrical energy” may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)

**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. (HS-PS3-5)

**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. (HSPS3- 1),(HS-PS3-2)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

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. (HS-PS3-2)

**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. (HS-PS4-1)

## Unit 3: Space (3 weeks; 6 weeks)

### Essential Questions:

**Core Idea ESS1: Earth's Place in the Universe**

**What is the universe, and what is Earth's place in it?**

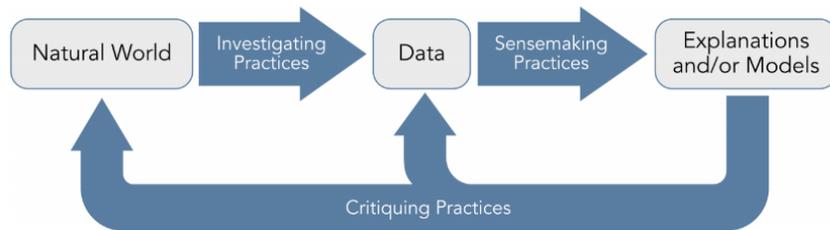
- What is the universe and what goes on in stars?
- What are the predictable patterns caused by Earth's movement in the solar system?
- How do people reconstruct and date events in Earth's planetary history?

**Core Idea PS2: Motion and Stability: Forces and Interactions**

**How can one explain and predict interactions between objects and within systems of objects?**

- How can one predict an object's continued motion, changes in motion, or stability?

**Possible Phenomena: Coming Soon**



	Investigating Practices	Sensemaking Practices	Critiquing Practices
	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
Science Practices	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
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### 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.

**[Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11- year sunspot cycle, and non-cyclic variations over centuries.] [Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]**

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<p style="text-align: center;"><b>HS-ESS1-2</b></p> <p>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.</p> <p><b>[Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]</b></p>	<p><b>Priority Standard</b></p>
<p style="text-align: center;"><b>HS-ESS1-3</b></p> <p>Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p> <p><b>[Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.]</b></p>	<p><b>Priority Standard</b></p>
<p style="text-align: center;"><b>HS-PS2-4</b></p> <p>Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.</p> <p><b>[Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]</b></p>	<p><b>Supporting Standard</b></p>
<p style="text-align: center;"><b>HS-ESS1-4</b></p> <p>Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</p> <p><b>[Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler’s Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]</b></p>	<p><b>Supporting Standard</b></p>

**Science and Engineering Practices:**

**Developing and Using Models**

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS1-1)

**Using Mathematical and Computational Thinking**

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)

Use mathematical representations of phenomena to describe explanations. (HSPS2-2),(HS-PS2-4)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3)

**Crosscutting concepts:****Scale, Proportion, and Quantity**

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4)

**Energy and Matter**

Energy cannot be created or destroyed– only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2)

In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HSESS1-3)

**Patterns**

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)

**Disciplinary Core Ideas:**

**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. (HSESS1-1)

The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HSESS1-3)

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. (HS-ESS1-2)

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. (HS-ESS1-2),(HS-ESS1-3)

**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. (HS-ESS1-4)

**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. (HSPS2-4)

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. (HS-PS2-4),(HS-PS2-5)

**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 to HS-ESS1-1)

**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 to HS-ESS1-2)

## Unit 4: Earth Plate Tectonics (3 weeks; 6 weeks)

### Essential Questions:

#### Core Idea ESS1: Earth's Place in the Universe

##### What is the universe, and what is Earth's place in it?

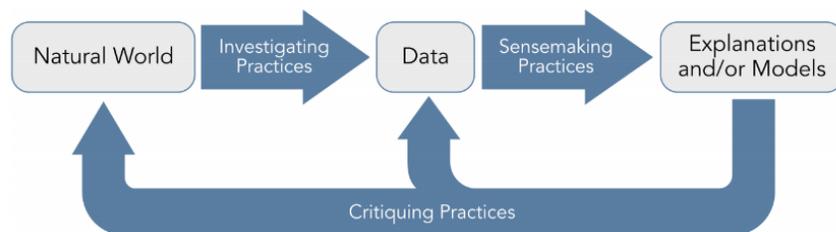
- How do people reconstruct and date events in Earth's planetary history?

#### Core Idea ESS2: Earth's Systems

##### How and why is Earth constantly changing?

- How do Earth's major systems interact?
- Why do the continents move, and what causes earthquakes and volcanoes?
- How do the properties and movements of water shape Earth's surface and affect its systems?

#### **Possible Phenomena: Coming Soon**



	Investigating Practices	Sensemaking Practices	Critiquing Practices
	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
Science Practices	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
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Possible Benchmarks: After Units 1, 2, 4

### 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.

**[Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic**

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<b>features of Earth's surface.]</b>	
<p style="text-align: center;"><b>HS-ESS1-5</b></p> <p>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.</p> <p><b>[Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.]</b></p>	<b>Priority Standard</b>
<p style="text-align: center;"><b>HS-ESS2-3</b></p> <p>Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.</p> <p><b>[Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.] HS-ESS2-5</b></p>	<b>Priority Standard</b>

<b>Science and Engineering Practices:</b>
<p><b>Developing and Using Models</b> Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1)</p> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)</p>

**Developing and Using Models**

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS2-3),(HS-ESS2-6)

**Crosscutting concepts:****Patterns**

Empirical evidence is needed to identify patterns. (HS-ESS1-5)

**Stability and Change**

Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)

**Energy and Matter**

Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

**Disciplinary Core Ideas:****ESS2.A: Earth Materials and Systems**

Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. A deep knowledge of how feedbacks work within and among Earth's systems is still lacking, thus limiting scientists' ability to predict some changes and their impacts. (HS-ESS2-1)

(Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.)

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. (HS-ESS2-3)

**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 to HS-ESS1-5),(HS-ESS2-1)

Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (ESS2.B Grade 8 GBE) (HSESS2-1)

**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. (HS-ESS1-5)

**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 to HS-ESS1-5),(secondary to HS-ESS1-6)

**PS4.A: Wave Properties**

Geologists use seismic waves and their reflection at interfaces between layers to predict

## Unit 5: Human Impact (3 weeks; 6 weeks)

**Essential Questions:**

**Core Idea ESS2: Earth's Systems**

**How and why is Earth constantly changing?**

- How do Earth's major systems interact?
- How do the properties and movements of water shape Earth's surface and affect its systems?
- What regulates weather and climate?
- How do living organisms alter Earth's processes and structures?

**Core Idea ESS3: Earth and Human Activity**

**How do Earth's surface processes and human activities affect each other?**

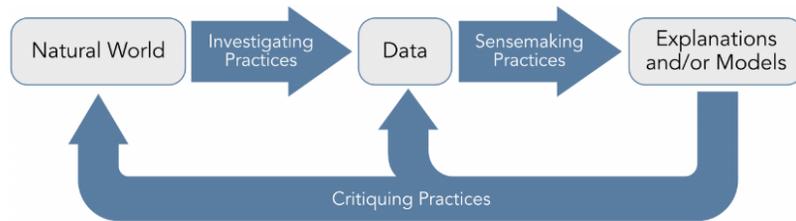
- How do humans depend on Earth's resources?
- How do natural hazards affect individuals and societies?
- How do humans change the planet?
- How do people model and predict the effect of human activities on Earth's climate?

**Core Idea ETS1: Engineering Design**

**How do engineers solve problems?**

- How can the various proposed design solutions be compared and improved?

**Possible Phenomena: Coming Soon**



	Investigating Practices	Sensemaking Practices	Critiquing Practices
Science Practices	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
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**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. 4

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<p><b>[Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]</b></p>	
<p style="text-align: center;"><b>HS-ESS3-5</b></p> <p>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's systems.<sup>4</sup></p> <p><b>[Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]</b></p>	<p><b>Priority Standard</b></p>
<p style="text-align: center;"><b>HS-ESS2-2</b></p> <p>Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.</p> <p><b>[Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]</b></p>	<p><b>Priority Standard</b></p>

<p style="text-align: center;"><b>HS-ETS1-3</b></p> <p>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p>	<p style="text-align: center;"><b>Supporting Standard</b></p>

<p><b>Science and Engineering Practices:</b></p>
<p><b>Constructing Explanations and Designing Solutions</b>  Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.  Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)  Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)</p> <p><b>Analyzing and Interpreting Data</b>  Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.  Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)  Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2- 2)</p>
<p><b>Crosscutting concepts:</b></p>
<p><b>Cause and Effect</b>  Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)</p> <p><b>Stability and Change</b>  Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5)  Feedback (negative or positive) can stabilize or destabilize a system. (HSESS2- 2)</p>
<p><b>Disciplinary Core Ideas:</b></p>

**ESS2.A: Earth Materials and Systems**

Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes (HSESS2- 2)

**ESS2.D: Weather and Climate**

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. (HS-ESS2- 2)

**ESS3.A: Natural Resources**

Resource availability has guided the development of human society. (HS-ESS3-1)

**ESS3.B: Natural Hazards**

Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

**ESS3.D: Global Climate Change**

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. (HS-ESS3-5)

**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. (HS-ETS1-3)