NEXT GENERATION SCIENCE STANDARDS

Inspire Physics is designed to meet 100% of the Next Generation Science Standards through both print and digital resources. The Student Edition, accessible in print and online, can be used as a research tool by students as they investigate concepts and collect evidence. Interactive Digital Content, labs, and projects that support the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts, as well as CCSS Mathematics and ELA/Literacy, are available online.

Correlation of *Inspire Physics* to the NGSS

HS-PS1	Matter and Its Interactions	
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.** *[Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]*	**Online:** Applying Practices: *Modeling Fission, Fusion, and Radioactive Decay* STEM Unit Project 6
SEP Science and Engineering Practices		
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook*: Practice 2
DCI 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.		**Student Edition:** 679–689, 682 Q 15-20, 683 Q21-24701
CCC Crosscutting Concepts		
Energy and Matter • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.		**Student Edition:** 685

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS Mathematics	
MP.4, N-Q.1-3	**Online:** Applying Practices: *Modeling Fission, Fusion, and Radioactive Decay* STEM Unit Project 6

HS-PS2	**Motion and Stability: Forces and Interactions**	
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.** [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.*]	**Online:** Applying Practices: *Newton's Second Law* STEM Unit Project 1
SEP Science and Engineering Practices		
Analyzing and Interpreting 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.		**Online:** *Science and Engineering Practices Handbook*: Practice 4
Connections to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Theories and laws provide explanations in science.		**Online:** *Science and Engineering Practices Handbook*: Practice 6 online **Student Edition:** 8–9
• Laws are statements or descriptions of the relationships among observable phenomena.		**Online:** *Science and Engineering Practices Handbook*: Practice 6 **Student Edition:** 8–9
DCI Disciplinary Core Ideas		
PS2.A: Forces and Motion • Newton's second law accurately predicts changes in the motion of macroscopic objects.		**Student Edition:** Student Edition: 89–92, 91 Q8, 94
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Student Edition:** 87

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS Mathematics	
MP.2, MP.4, N-Q.1-3, A-SSE.1.a,b, A-SSE.3.a-c, A-CED.1, A-CED.2, A-CED.4, F-IF.7.a-e, S-ID.1	**Online:** Applying Practices: *Newton's Second Law* STEM Unit Project 1
CCSS ELA/Literacy	
RST.11-12.1, RST.11-12.7, WHST.9–12.9	**Online:** Applying Practices: *Newton's Second Law* STEM Unit Project 1

HS-PS2	**Motion and Stability: Forces and Interactions**	
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.** [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.*]	**Online:** Applying Practices: *Conservation of Momentum* Applying Practices: *Use Mathematical Representations of Momentum* STEM Unit Project 3
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena to describe explanations.		**Online:** *Science and Engineering Practices Handbook*: Practice 5
DCI Disciplinary Core Ideas		
PS2.A: Forces and Motion • Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.		**Student Edition:** 213–217, 221, 221 Q14, 231 Q30
• 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.		**Student Edition:** 222–229
CCC Crosscutting Concepts		
Systems and System Models • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.		**Student Edition:** 225

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS Mathematics	
MP.2, MP.4, N-Q.1-3, A-CED.1, A-CED.2, A-CED.4	**Online:** Applying Practices: *Conservation of Momentum* Applying Practices: *Use Mathematical Representations of Momentum* STEM Unit Project 3

HS-PS2	Motion and Stability: Forces and Interactions	
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 the 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.*]	**Online:** Applying Practices: *Egg Heads* STEM Unit Project 3
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.		**Online:** *Science and Engineering Practices Handbook*: Practice 6
DCI Disciplinary Core Ideas		
PS2.A: Forces and Motion • 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.		**Student Edition:** 222–229
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. (secondary)		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6
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 (trade-offs) may be needed. (secondary)		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
Cause and Effect • Systems can be designed to cause a desired effect.	**Student Edition:** 219
CCSS ELA/Literacy	
WHST.9–12.7	**Online:** Applying Practices: *Egg Heads* STEM Unit Project 3

HS-PS2	Motion and Stability: Forces and Interactions	
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.** [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.*]	**Online:** Applying Practices: *Gravitational and Electrostatic Forces* STEM Unit Project 2 STEM Unit Project 5

SEP Science and Engineering Practices	
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena to describe explanations.	**Online:** *Science and Engineering Practices Handbook*: Practice 5
Connections to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Theories and laws provide explanations in science.	**Online:** *Science and Engineering Practices Handbook*: Practice 6 **Student Edition:** 8–9
• Laws are statements or descriptions of the relationships among observable phenomena.	**Online:** *Science and Engineering Practices Handbook*: Practice 6 **Student Edition:** 8–9

DCI 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.	**Student Edition:** 166–170, 170 Q9-Q10, 175–176, 481–485, 485 Q15, 486–492
• 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.	**Student Edition:** 175–176, 176 Get It?, 179, 486–503, 550–555, 555 Q12-Q14, 570–573, 577, 594–595

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
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.	**Student Edition:** 169
CCSS Mathematics	
MP.2, MP.4, N-Q.1-3, A-SSE.1.a,b, A-SSE.3.a-c	**Online:** Applying Practices: *Gravitational and Electrostatic Forces* STEM Unit Project 2 STEM Unit Project 5

HS-PS2	Motion and Stability: Forces and Interactions	
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.*]	**Online:** Applying Practices: *Investigate Electromagnetism* STEM Unit Project 5
SEP Science and Engineering Practices		
Planning and Carrying Out Investigations • 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.		**Online:** *Science and Engineering Practices Handbook*: Practice 3
DCI 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.		**Student Edition:** 166–170, 170 Q9-Q10, 175–176, 481–485, 485 Q 15, 86–492
• 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.		**Student Edition:** 175–176, 176 Get It?, 179, 486–503, 550–555, 555 Q12-Q14, 570–573, 577, 594–595
PS3.A: Definitions of Energy • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary)		**Student Edition:** 493–503, 509–519, 519 Q19

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 580
CCSS Mathematics	
N-Q.1-3	**Online:** Applying Practices: *Investigate Electromagnetism* STEM Unit Project 5
CCSS ELA/Literacy	
WHST.9–12.7, WHST.11-12.8, WHST.9–12.9	**Online:** Applying Practices: *Investigate Electromagnetism* STEM Unit Project 5

HS-PS2	Motion and Stability: Forces and Interactions	
HS-PS2-6.	**Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*** [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [*Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*]	**Online:** Applying Practices: *Gravitational and Electrostatic Forces* Applying Practices: *Touching the Future* STEM Unit Project 5
SEP Science and Engineering Practices		
Obtaining, Evaluating, and Communicating Information • Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).		**Science and Engineering Practices Handbook:** Practice 8 online
DCI Disciplinary Core Ideas		
PS2.B: Types of Interactions • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.		**Student Edition:** 472–476, 477–485, 675

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
Structure and Function • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
N-Q.1-3	**Online:** Applying Practices: *Gravitational and Electrostatic Forces* Applying Practices: *Touching the Future* STEM Unit Project 5
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e	**Online:** Applying Practices: *Gravitational and Electrostatic Forces* Applying Practices: *Touching the Future* STEM Unit Project 5

HS-PS3	Energy	
HS-PS3-1.	**Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.** [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]	**Online:** Applying Practices: *Modeling Changes in Energy* STEM Unit Project 3
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Create a computational model or simulation of a phenomenon, designed device, process, or system.		**Online:** *Science and Engineering Practices Handbook*: Practice 5
DCI 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.		**Student Edition:** 243, 249–266, 255 Get It?, 266 Q48, 282–289, 291–297

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

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.	**Student Edition:** 243–244, 257–266, 266 Q52, 295–297, 493
• Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	**Student Edition:** 243–256, 257–266, 266 Q52, 282–290, 295–300
• 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.	**Student Edition:** 243–266, 262 Q39, 339–341, 340 Fig 3 caption question
• The availability of energy limits what can occur in any system.	**Student Edition:** 243, 258, 259 Get It?
CCC Crosscutting Concepts	
Systems and System Models • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.	**Student Edition:** 258
Connections to Nature of Science **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes the universe is a vast single system in which basic laws are consistent.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 8
CCSS Mathematics	
MP.2, MP.4, N-Q.1-3	**Online:** Applying Practices: *Modeling Changes in Energy* STEM Unit Project 3
CCSS ELA/Literacy	
SL.11-12.5	**Online:** Applying Practices: *Modeling Changes in Energy* STEM Unit Project 3

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

HS-PS3	Energy	
HS-PS3-2.	**Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.** [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.]	**Online:** Applying Practices: *Modeling Energy at Different Scales* Applying Practices: *Develop and Use Models for Energy* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook*: Practice 2
DCI 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.		**Student Edition:** 243, 249–266, 255 Get It?, 266 Q48, 282–289, 291–297
• At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.		**Student Edition:** 244, 248–260, 256 Q 35, 339, 345
• These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.		**Student Edition:** 175–176, 244, 248–256, 280–300, 486–503, 509–512, 547–555, 594–603
CCC Crosscutting Concepts		
Energy and Matter • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		**Student Edition:** 255
• Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.		**Student Edition:** 259
CCSS Mathematics		
MP.2, MP.4		**Online:** Applying Practices: *Modeling Energy at Different Scales* Applying Practices: *Develop and Use Models for Energy* STEM Unit Project 3 STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS ELA/Literacy	
SL.11-12.5	**Online:** Applying Practices: *Modeling Energy at Different Scales* Applying Practices: *Develop and Use Models for Energy* STEM Unit Project 3 STEM Unit Project 5

HS-PS3	**Energy**	
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.*** [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]	**Online:** Applying Practices: *Earth Power* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.		**Online:** *Science and Engineering Practices Handbook*: Practice 6
DCI Disciplinary Core Ideas		
PS3.A: Definitions of Energy • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.		**Student Edition:** 244, 248–260, 256 Q 35, 339, 345
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.		**Student Edition:** 257–266, 259 Get It?, 300
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. (secondary)		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
Energy and Matter • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.	**Student Edition:** 255
Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering and Technology on Society and the Natural World** • Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
MP.2, MP.4, N-Q.1-3	**Online:** Applying Practices: *Earth Power* STEM Unit Project 3 STEM Unit Project 5
CCSS ELA/Literacy	
WHST.9–12.7	**Online:** Applying Practices: *Earth Power* STEM Unit Project 3 STEM Unit Project 5

HS-PS3	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).** [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]	**Online:** Applying Practices: *Coffee Cup Calorimetry* STEM Unit Project 3
SEP Science and Engineering Practices		
Planning and Carrying Out Investigations • 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.		**Online:** *Science and Engineering Practices Handbook*: Practice 3

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

DCI Disciplinary Core Ideas	
PS3.B: Conservation of Energy and Energy Transfer • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	**Student Edition:** 243–244, 248–256, 257–266, 266 Q52, 282–290, 295–300
• 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).	**Student Edition:** 280–283, 282 Get It?, 298
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.	**Student Edition:** 257–266, 259 Get It?, 300
CCC Crosscutting Concepts	
Systems and System Models • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.	**Student Edition:** 298
CCSS Mathematics	
MP.2, MP.4	**Online:** Applying Practices: *Coffee Cup Calorimetry* STEM Unit Project 3
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.7, WHST.11-12.8, WHST.9–12.9	**Online:** Applying Practices: *Coffee Cup Calorimetry* STEM Unit Project 3

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

HS-PS3	Energy	
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.** [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.]	**Online:** Applying Practices: *Modeling Magnetic Fields* STEM Unit Project 5
SEP Science and Engineering Practices		
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook*: Practice 2
DCI 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.		**Student Edition:** 175–176, 486–492, 492 Q41, 493–503, 547–564, 570–585
CCC Crosscutting Concepts		
Cause and Effect • 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.		**Student Edition:** 553
CCSS Mathematics		
MP.2, MP.4		**Online:** Applying Practices: *Modeling Magnetic Fields* STEM Unit Project 5
CCSS ELA/Literacy		
WHST.9–12.7, WHST.11-12.8, WHST.9–12.9, SL.11-12.5		**Online:** Applying Practices: *Modeling Magnetic Fields* STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

HS-PS4	Waves and Their Applications in Technologies for Information Transfer	
HS-PS4-1.	**Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** [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.*]	**Online:** Applying Practices: *Wave Characteristics* STEM Unit Project 4
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.		**Online:** *Science and Engineering Practices Handbook*: Practice 5
DCI Disciplinary Core Ideas		
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.		**Student Edition:** 346–349, 349 Q26, 362–363, 368, 370–374, 400–403, 426–431, 595–598
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Student Edition:** 354
CCSS Mathematics		
MP.2, MP.4, A-SSE.1.a,b, A-SSE.3.a-c, A.CED.4		**Online:** Applying Practices: *Wave Characteristics* STEM Unit Project 4
CCSS ELA/Literacy		
RST.11-12.7		**Online:** Applying Practices: *Wave Characteristics* STEM Unit Project 4

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

HS-PS4	Waves and Their Applications in Technologies for Information Transfer	
HS-PS4-2.	**Evaluate questions about the advantages of using a digital transmission and storage of information.** [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]	**Online:** Applying Practices: *Digital Transmission and Storage of Information* Applying Practices: *Evaluate the Advantages of Digitized Information* STEM Unit Project 5

SEP Science and Engineering Practices	
Asking Questions and Defining Problems • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.	**Online:** *Science and Engineering Practices Handbook*: Practice 1
DCI Disciplinary Core Ideas	
PS4.A: Wave Properties • 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.	**Student Edition:** 598–603, 619
CCC Crosscutting Concepts	
Stability and Change • Systems can be designed for greater or lesser stability.	**Student Edition:** 600
Connections to Engineering, Technology, and Applications of Science **Influence of Engineering, Technology, and Science on Society and the Natural World** • Modern civilization depends on major technological systems.	**Online:** *Science and Engineering Practices Handbook*
• Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	**Online:** *Science and Engineering Practices Handbook*
CCSS ELA/Literacy	
RST.11-12.1, RST.9-10.8, RST.11-12.8	**Online:** Applying Practices: *Digital Transmission and Storage of Information* Applying Practices: *Evaluate the Advantages of Digitized Information* STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

NEXT GENERATION SCIENCE STANDARDS

HS-PS4	Waves and Their Applications in Technologies for Information Transfer	
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.** [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [*Assessment Boundary: Assessment does not include using quantum theory.*]	**Online:** Applying Practices: *Is light a wave or a particle?* STEM Unit Project 6
SEP Science and Engineering Practices		
Engaging in Argument from Evidence • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.		**Online:** *Science and Engineering Practices Handbook*: Practice 7
Connections to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.		**Student Edition:** 8 **Online:** *Science and Engineering Practices Handbook*: Practice 6
DCI Disciplinary Core Ideas		
PS4.A: Wave Properties • [From the 3–5 grade band endpoints] 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.)		**Student Edition:** 346, 351–353, 352 Fig 15 caption question
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.		**Student Edition:** 385, 385 Fig 1 caption question, 394–395, 398, 400–403, 594–597, 612–624
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Student Edition:** 614

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS Mathematics	
MP.2, A-SSE.1.a,b, A-SSE.3.a-c, A.CED.4	**Online:** Applying Practices: *Is light a wave or a particle?* STEM Unit Project 6
CCSS ELA/Literacy	
RST.11-12.1, RST.9-10.8, RST.11-12.8	**Online:** Applying Practices: *Is light a wave or a particle?* STEM Unit Project 6

HS-PS4	**Waves and Their Applications in Technologies for Information Transfer**	
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.** [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [*Assessment Boundary: Assessment is limited to qualitative descriptions.*]	**Online:** Applying Practices: *Human Health and Radiation Frequency* STEM Unit Project 5
SEP Science and Engineering Practices		
Obtaining, Evaluating, and Communicating Information • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.		**Online:** *Science and Engineering Practices Handbook*: Practice 8
DCI Disciplinary Core Ideas		
PS4.B: Electromagnetic Radiation • 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.		**Student Edition:** 596–597, 603 Q47
CCC Crosscutting Concepts		
Cause and Effect • 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.		**Student Edition:** 600

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS ELA/Literacy	
RST.11-12.1, RST.11-12.7, RST.9-10.8, RST.11-12.8, WHST.11-12.8	**Online:** Applying Practices: *Human Health and Radiation Frequency* STEM Unit Project 5

HS-PS4	**Waves and Their Applications in Technologies for Information Transfer**	
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.*** [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [*Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.*]	**Online:** Applying Practices: *Catching Waves* Applying Practices: *Communicate Information About Multiple Technologies* STEM Unit Project 4 STEM Unit Project 5
SEP Science and Engineering Practices		
Otaining, Evaluating, and Communicating Information • Communicate technical information or 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).		**Online:** *Science and Engineering Practices Handbook*: Practice 8
DCI Disciplinary Core Ideas		
PS3.D: Energy in Chemical Processes • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary)		**Student Edition:** 310, 404, 615–616, 624 Q19
PS4.A: Wave Properties • 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.		**Student Edition:** 598–603, 619
PS4.B: Electromagnetic Radiation • Photovoltaic materials emit electrons when they absorb light of a high-enough frequency.		**Student Edition:** 615–622, 624 Q16
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.		**Student Edition:** 368, 596–603, 645

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCC Crosscutting Concepts	
Cause and Effect • Systems can be designed to cause a desired effect.	**Student Edition:** 600
Influence of Engineering, Technology, and Science on Society and the Natural World • Modern civilization depends on major technological systems.	**Online:** *Science and Engineering Practices Handbook*
CCSS ELA/Literacy	
WHST.9–12.2.a–e	**Online:** Applying Practices: *Catching Waves* Applying Practices: *Communicate Information About Multiple Technologies* STEM Unit Project 4 STEM Unit Project 5

HS-ESS1	Earth's Place in the Universe	
HS-ESS1-4.	**Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.** [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.*]	**Online:** Applying Practices: *Planetary Orbits* STEM Unit Project 2

SEP Science and Engineering Practices	
Using Mathematical and Computational Thinking • Use mathematical or computational representations of phenomena to describe explanations.	**Online:** *Science and Engineering Practices Handbook*: Practice 5
DCI Disciplinary Core Ideas	
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.	**Student Edition:** 162–167
CCC Crosscutting Concepts	
Scale, Proportion, and Quantity • 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).	**Online:** *Science and Engineering Practices Handbook*

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

Connections to Engineering, Technology, and Applications of Science **Interdependence of Science, Engineering, and Technology** • Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
MP.2, MP.4, N-Q.1-3, A-SSE.1.a,b, A-CED.2, A-CED.4	**Online:** Applying Practices: *Planetary Orbits* STEM Unit Project 2

HS-ETS1	**Engineering Design**	
HS-ETS1-1.	**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**	**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Asking Questions and Defining Problems • Analyze complex real-world problems by specifying criteria and constraints for successful solutions.		**Online:** *Science and Engineering Practices Handbook*: Practice 1
DCI Disciplinary Core Ideas		
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.		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6
• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.		**Online:** *Science and Engineering Practices Handbook*: Introduction, All Practices
CCC Crosscutting Concepts		
Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.		STEM Unit Project 3 STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

CCSS Mathematics	
MP.2, MP.4	**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5
CCSS ELA/Literacy	
RST.11-12.7, RST.11-12.8, RST.11-12.9	**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5

HS-ETS1	**Engineering Design**	
HS-ETS1-2.	**Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**	**Online:** Applying Practices: *Engineer a Better World: Design a Solution* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.		**Online:** *Science and Engineering Practices Handbook*: Practice 6
DCI Disciplinary Core Ideas		
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 (trade-offs) may be needed.		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6
CCSS Mathematics		
MP.4		**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

HS-ETS1	Engineering Design	
HS-ETS1-3.	**Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**	**Online:** Applying Practices: *Engineer a Better World: Evaluate a Solution* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.		**Online:** *Science and Engineering Practices Handbook*: Practice 6
DCI Disciplinary Core Ideas		
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.		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6
CCC Crosscutting Concepts		
Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.		**Online:** *Science and Engineering Practices Handbook* STEM Unit Project 3 STEM Unit Project 5
CCSS Mathematics		
MP.2, MP.4		**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5
CCSS ELA/Literacy		
RST.11-12.7, RST.11-12.8, RST.11-12.9		**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

HS-ETS1	Engineering Design	
HS-ETS1-4.	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**	**Online:** Applying Practices: *Engineer a Better World: Use a Computer Simulation* STEM Unit Project 3 STEM Unit Project 5
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.		**Online:** *Science and Engineering Practices Handbook*: Practice 5
DCI Disciplinary Core Ideas		
ETS1.B: Developing Possible Solutions • Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.		**Student Edition:** 7–8, 9, 9 Q4 **Online:** *Science and Engineering Practices Handbook*: Practice 2, Practice 5, Practice 6
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Online:** *Science and Engineering Practices Handbook* STEM Unit Project 3 STEM Unit Project 5
CCSS Mathematics		
MP.2, MP.4		**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 3 STEM Unit Project 5

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

HS-ESS1	Earth's Place in the Universe	
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.]*	**Online:** Applying Practices: *The Sun's Energy Formation and Radiation* STEM Unit Project 6 Interactive Content placed at Module 24 Lesson 2.
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.** *[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).]*	**Online:** Applying Practices: *The Big Bang Theory* STEM Unit Project 6 Interactive Content placed at Unit 6.
HS-ESS1-3.	**Communicate scientific ideas about the way stars, over their life cycle, produce elements.** *[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.]*	**Online:** Applying Practices: *Element Production in Stars* STEM Unit Project 6 Interactive Content placed at Module 24 Lesson 2.
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.** *[Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).]*	**Online:** Applying Practices: *How old are crustal rocks?* STEM Unit Project 6 Interactive Content placed at Module 24 Lesson 2.

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

Continued from previous page.

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.** *[Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]*	**Online:** Applying Practices: *Earth's Formation and Early History* STEM Unit Project 6 Interactive Content placed at Unit 6.

HS-ESS2	Earth's Systems	
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 features of Earth's surface.]*	**Online:** Applying Practices: *Modeling Earth's Internal and Surface Processes* STEM Unit Project 4 STEM Unit Project 6 Interactive Content placed at Unit 4.

HS-ESS3	Earth and Human Activity	
HS-ESS3-2.	**Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*** *[Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.]*	**Online:** Applying Practices: *Environmental Consulting: Finding Solutions* STEM Unit Project 5 Interactive Content placed at Unit 5.

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.

HS-ESS3-3.	**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.** *[Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]*	**Online:** Applying Practices: *Modeling Relationships: Resource Management, Human Sustainability, and Biodiversity* STEM Unit Project 5 Interactive Content placed at Unit 5.

THIS INFORMATION IS PROVIDED FOR INDIVIDUAL EDUCATIONAL PURPOSES ONLY AND MAY NOT BE DOWNLOADED OR FURTHER DISTRIBUTED.