# Science Course Pathways for Middle and High School

On April 27th, 2015, a work group of science teachers, higher education representatives, administrators and instructional leaders gathered to create recommended model course pathways for both middle school and high school. In short, the group recommends that all students take the following courses to ensure that all students receive all standards.

Middle School: 6th Grade Earth Science; 7th Grade Life Science; 8th Grade Physical Science
High School: Biology; Chemistry; Physics

*The recommended organization of the standards and justification for the pathways begins on page 2 of this document.*

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|---|---|---|
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# Middle School Standards Pathway

The Board adopted grade-banded standards in middle school for life, earth/space and physical science. The course pathway group recommends that schools split them into earth in 6th, life in 7th and physical in 8th. This is not moving high school standards or a high school course from 9th grade to 8th grade, but rather appropriating all of the physical science standards from grade-bands 6-8 (how they were written) into only 8th grade. The workgroup feels that the modeling in Earth/Space science is conceptually tractable for students at grades 6, since the many of the models can be directly observed. Physical science uses many more models that are conceptually challenging. Furthermore, students will have additional exposure to Earth Science as it is integrated into high school science courses.

| Sixth Grade Earth and Space Science Standards | |
|---|---|
| MS-ESS1-1 | Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. (SEP: 2; DCI: ESS1.A, ESS1.B; CCC: Patterns) |
| MS-ESS1-2 | Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. (SEP: 2; DCI: ESS1.A, ESS1.B; CCC: Systems) |
| MS-ESS1-3 | Analyze and interpret data to determine scale properties of objects in the solar system. (SEP: 4; DCI: ESS1.B; CCC: Scale/Prop., Technology) |
| MS-ESS2-1 | Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. (SEP: 2; DCI: ESS2.A; CCC: Stability/Change) |
| MS-ESS2-2 | Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (SEP: 6; DCI: ESS2.A, ESS2.C; CCC: Scale/Prop.) |
| MS-ESS2-3 | Analyze and interpret data on the age of the Earth, distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. (SEP: 4; DCI: ESS2.B, ESS1.C; CCC: Patterns) |
| MS-ESS2-4 | Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. (SEP: 2; DCI: ESS2.C; CCC: Energy/Matter) |
| MS-ESS2-5 | Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. (SEP: 3; DCI: ESS2.C, ESS2.D; CCC: Cause/Effect) |
| MS-ESS2-6 | Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (SEP: 2; DCI: ESS2.C, ESS2.D; CCC: Systems) |
| MS-ESS3-1 | Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (SEP: 6; DCI: ESS3.A ; CCC: Cause/Effect , Technology) |
| MS-ESS3-2 | Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (SEP: 4; DCI: ESS3.B; CCC: Patterns, Technology) |
| MS-ESS3-3 | Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* (SEP: 6 ; DCI: ESS3.C; CCC: Cause/Effect, Technology) |
| MS-ESS3-4 | Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (SEP: 7; DCI: ESS3.C; CCC: Cause/Effect, Technology, Nature Science/Consequence-Actions) |
| MS-ESS3-5 | Ask questions to clarify evidence of the factors that may have caused a change in global temperatures over the past century. (SEP: 1; DCI: ESS3.D; CCC: Stability/Change) |

| Seventh Grade Life Science Standards | |
|---|---|
| MS-LS1-1 | Plan and carry out an investigation to provide evidence that living things are made of cells; either one cell or many different types and numbers of cells. (SEP: 3; DCI: LS1.A; CCC: Scale/Prop., Technology) |
| MS-LS1-2 | Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (SEP: 2; DCI: LS1.A; CCC: Structure/Function) |
| MS-LS1-3 | Construct an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (SEP: 7 ; DCI: LS1.A; CCC: Systems) |
| MS-LS1-4 | Construct an argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. (SEP: 7; DCI: LS1.B; CCC: Cause/Effect) |
| MS-LS1-5 | Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (SEP: 6; DCI: LS1.B; CCC: Cause/Effect) |
| MS-LS1-6 | Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (SEP: 6, Nature Science/Empirical Evidence; DCI: LS1.C, PS3.D; CCC: Energy/Matter) |
| MS-LS1-7 | Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (SEP: 2; DCI: LS1.C, PS3.D; CCC: Energy/Matter) |
| MS-LS2-1 | Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (SEP: 4; DCI: LS2.A; CCC: Cause/Effect) |
| MS-LS2-2 | Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (SEP: 6; DCI: LS2.A; CCC: Patterns) |
| MS-LS2-3 | Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (SEP: 2; DCI: LS2.B; CCC: Energy/Matter) |
| MS-LS2-4 | Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (SEP: 7; DCI: LS2.C ; CCC: Stability/Change) |
| MS-LS2-5 | Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* (SEP: 7; DCI: LS2.C, LS4.D, ETS1.B ; CCC: Stability/Change, Technology) |
| MS-LS3-1 | Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. (SEP:2 ; DCI: LS3.A, LS3.B; CCC: Structure/Function) |
| MS-LS3-2 | Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. (SEP: 2; DCI: LS1.B, LS3.A, LS3.B; CCC: Cause/Effect) |
| MS-LS4-1 | Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth. (SEP: 4; DCI: LS4.A; CCC: Patterns) |
| MS-LS4-2 | Apply scientific ideas to construct an explanation for similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (SEP: 6; DCI: LS4.A; CCC: Patterns) |
| MS-LS4-4 | Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. (SEP: 6; DCI: LS4.B; CCC: Cause/Effect) |
| MS-LS4-5 | Obtain, evaluate, and communicate information about how technological advances have changed the way humans influence the inheritance of desired traits in organisms. * (SEP: 8; DCI: LS4.B; CCC: Cause/Effect, Technology) |
| MS-LS4-6 | Use mathematical representations to support explanations of how natural selection may lead to |

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| | increases and decreases of specific traits in populations over time. (SEP: 5; DCI: LS4.C; CCC: Cause/Effect) |

| Eighth Grade Physical Science Standards | |
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| MS-PS1-1 | Develop models to describe the atomic composition of simple molecules and extended structures. (SEP:2 ; DCI: PS1.A; CCC: Scale/Prop. ) |
| MS-PS1-2 | Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (SEP: 8; DCI: PS1.A, PS1.B; CCC: Patterns) |
| MS-PS1-3 | Obtain and evaluate information to describe that synthetic materials come from natural resources and impact society. (SEP: 8; DCI: PS1.A, PS1.B; CCC: Structure/Function, Technology ) |
| MS-PS1-4 | Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. (SEP: 2; DCI: PS1.A, PS3.A; CCC: Cause/Effect) |
| MS-PS1-5 | Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. (SEP: 2 ; DCI: PS1.B; CCC: Energy/Matter) |
| MS-PS1-6 | Design, construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* (SEP: 6; DCI: PS1.B, ETS1.B, ETS1.C; CCC: Energy/Matter) |
| MS-PS2-1 | Design a solution to a problem involving the motion of two colliding objects that illustrates Newton's Third Law.* (SEP: 6; DCI: PS2.A; CCC: Systems, Technology) |
| MS-PS2-2 | Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (SEP: 3; DCI: PS2.A; CCC: Stability/Change ) |
| MS-PS2-3 | Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (SEP: 1; DCI: PS2.B; CCC: Cause/Effect) |
| MS-PS2-4 | Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (SEP: 7; DCI: PS2.B; CCC: Systems) |
| MS-PS2-5 | Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. (SEP: 3; DCI: PS2.B; CCC: Cause/Effect ) |
| MS-PS3-1 | Construct and analyze graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (SEP: 4; DCI: PS3.A; CCC: Scale/Prop.) |
| MS-PS3-2 | Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. (SEP: 2; DCI: PS3.A, PS3.C ; CCC: Systems) |
| MS-PS3-3 | Design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* (SEP: 6; DCI: PS3.A, PS3.B, ETS1.A, ETS1.B, ; CCC: Energy/Matter) |
| MS-PS3-4 | Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (SEP: 3; DCI: PS3.A, PS3.B; CCC: Scale/Prop.) |
| MS-PS3-5 | Engage in argument from evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (SEP: 7; DCI: PS3.B; CCC: Energy/Matter) |
| MS-PS4-1 | Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. (SEP: 5; DCI: PS4.A; CCC: Patterns) |
| MS-PS4-2 | Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials. (SEP: 2; DCI: PS4.A, PS4.B; CCC: Structure) |
| MS-PS4-3 | Obtain, evaluate and communicate information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (SEP: 8; DCI: PS4.C; CCC: Structure, Technology) |

# High School Standards Pathway

Since students are required to obtain all standards in a span of three years, it is the workgroup's recommendation that students take biology, chemistry and physics. Additional Earth/Space standards should be integrated throughout those courses. The work group tried different combinations of courses, but found that this pathway was the only one that reasonably allowed all standards to be included within three units of science.

**Nov. 2, 2009 Graduation Requirements**

Students need three units (courses) in Science and need to meet all standards. Alternate pathways that are different from the recommended pathway are going to prove difficult in meeting all standards. Therefore, the recommendation of the course pathway workgroup is that students take Biology, Chemistry, and Physics to ensure that students are able to meet all standards by taking the required three units. However, there is flexibility within the current requirements to ensure that schools are able to build pathways appropriate to each individual student. If a student would benefit from an alternative pathway, the school is able to adjust courses/standards accordingly.

| Graduation Requirements: Three units of Lab Science | |
|---|---|
| **Must include:** | **Recommended Pathway** |
| a. Biology – 1 unit | Biology |
| b. Any Physical Science – 1 unit | Chemistry |
| c. *Chemistry or Physics – 1 unit<br>*With school and parent/guardian approval, a student may be excused from this course in favor of a more appropriate course. A student may be excused from Algebra II or Geometry, but not both. A student is still required to take three units of Math. If a student is excused from Chemistry or Physics, the student must still take three units of Lab Science. | Physics |

*Table 1* displays how all high school standards fit into three courses: Biology, Chemistry and Physics. The Course Pathway Workgroup arranged all of the 9-12 Physical Science standards into Chemistry and Physics. Some standards are duplicative for each course, but all physical science standards are covered by Chemistry and Physics. The workgroup also identified standards to be covered in a traditional Physical Science course. However, the group does not recommend Physical Science due to the following issues describes by the chart, below. There are three situations the group came up with and one is recommended for all students.

1. Situation 1 – If a student took Physical Science, Biology and Chemistry, then he or she would miss the standards from Physics (Highlighted Yellow in the last column).
2. Situation 2 - If a student took Physical Science, Biology, and Physics, then he or she would miss standards from Chemistry (Highlighted Blue in the last column).
3. Situation 3 – The student takes Biology, Chemistry, and Physics where all standards are included. This is recommended pathway.

| Table 1: Standard Distribution for General HS Science Courses | | | | |
|---|---|---|---|---|
| **Standards** | **Biology** | **Chemistry** | **Physics** | **Physical Science*** |
| HS-PS1- 1 | | X | | X |
| HS-PS1-2 | | X | | X |
| HS-PS1-3 | | X | X | Chemistry and Physics |
| HS-PS1-4 | | X | | Chemistry |
| HS-PS1-5 | | X | | Chemistry |
| HS-PS1-6 | | X | | Chemistry |
| HS-PS1-7 | | X | | X |
| HS-PS1-8 | | X | | X |
| HS-PS2-1 | | | X | X |
| HS-PS2-2 | | | X | X |
| HS-PS2-3 | | | X | X |
| HS-PS2-4 | | | X | Physics |
| HS-PS2-5 | | X | X | X |
| HS-PS2-6 | | X | X | Chemistry and Physics |
| HS-PS3-1 | | X | X | Chemistry and Physics |
| HS-PS3-2 | | X | | X |
| HS-PS3-3 | | X | | X |
| HS-PS3-4 | | X | X | X |
| HS-PS3-5 | | | X | Physics |
| HS-PS4-1 | | | X | X |
| HS-PS4-2 | | | X | Physics |
| HS-PS4-3 | | | X | X |
| HS-PS4-4 | | | X | Physics |
| HS-PS4-5 | | | X | Physics |
| HS-ESS1-1 | | X | | Chemistry |
| HS-ESS1-2 | | X | | Chemistry |
| HS-ESS1-3 | | X | | Chemistry |
| HS-ESS1-4 | | | X | Physics |
| HS-ESS1-5 | | | X | Physics |
| HS-ESS1-6 | | | X | Physics |
| HS-ESS2-1 | | | X | Physics |
| HS-ESS2-2 | | | X | Physics |
| HS-ESS2-3 | | | X | Physics |
| HS-ESS2-4 | | | X | Physics |
| HS-ESS3-1 | | X | | Chemistry |
| HS-ESS3-2 | | X | | Chemistry |
| HS-ESS3-3 | | X | | Chemistry |
| HS-ESS3-4 | | x | | Chemistry |
| HS-ESS3-5 | X | | | |
| HS-ESS3-6 | X | | | |
| HS-LS1-1 to LS4-7 | X | | | |
| **Color Key:** | | | | |
| **Blue** = Standards only covered in a Chemistry Course | | | | |
| **Yellow** = Standards only covered in a Physics Course | | | | |
| **Green** = Standards covered in both Chemistry and Physics | | | | |

# Recommended High School Course Pathway

| High School Biology | |
|---|---|
| HS-LS1-1 | Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. (SEP: 6; DCI: LS1.A; CCC: Structure/Function) |
| HS-LS1-2 | Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (SEP: 2; DCI: LS1.A; CCC: Systems) |
| HS-LS1-3 | Plan and carry out an investigation to provide evidence that feedback mechanisms maintain homeostasis. (SEP: 3; DCI: LS1.A; CCC: Stability/Change) |
| HS-LS1-4 | Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. (SEP: 2; DCI: LS1.B; CCC: Systems) |
| HS-LS1-5 | Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (SEP: 2; DCI: LS1.C; CCC: Systems, Energy/Matter) |
| HS-LS1-6 | Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. (SEP: 6; DCI: LS1.C; CCC: Energy/Matter) |
| HS-LS1-7 | Use a model of the major inputs and outputs of cellular respiration (aerobic and anaerobic) to exemplify the chemical process in which the bonds of food molecules are broken, the bonds of new compounds are formed, and a net transfer of energy results. (SEP: 2; DCI: LS1.C; CCC: Energy/Matter) |
| HS-LS2-1 | Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (SEP: 5; DCI: LS2.A; CCC: Scale/Prop.) |
| HS-LS2-2 | Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (SEP: 5; DCI: LS2.A, LS2.C; CCC: Scale/Prop.) |
| HS-LS2-3 | Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. (SEP:6; DCI: LS2.B; CCC: Energy/Matter ) |
| HS-LS2-4 | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. (SEP: 5; DCI: LS2.B; CCC: Energy/Matter) |
| HS-LS2-5 | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (SEP: 2; DCI: LS2.B, PS3.D; CCC: Systems) |
| HS-LS2-6 | Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable conditions; however, moderate to extreme fluctuations in conditions may result in new ecosystems. (SEP: 7; DCI: LS2.C; CCC: Stability/Change) |
| HS-LS2-7 | Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* (SEP: 6; DCI: LS2.C, LS4.D, ETS1.B; CCC: Stability/Change) |
| HS-LS2-8 | Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. (SEP: 7; DCI: LS2.D; CCC: Cause/Effect) |
| HS-LS3-1 | Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. (SEP: 1; DCI: LS1.A, LS3.A; CCC: Cause/Effect) |
| HS-LS3-2 | Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. (SEP: 7; DCI: LS3.B; CCC: Cause/Effect) |
| HS-LS3-3 | Apply concepts of statistics and probability to explain the variation and distribution of expressed |

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| | traits in a population. (SEP: 4; DCI: LS3.B; CCC: Scale/Prop.) |
| HS-LS4-1 | Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. (SEP: 8; DCI: LS4.A; CCC: Patterns) |
| HS-LS4-2 | Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. (SEP: 6; DCI: LS4.B, LS4.C; CCC: Cause/Effect) |
| HS-LS4-3 | Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (SEP: 4; DCI: LS4.B, LS4.C; CCC: Patterns) |
| HS-LS4-4 | Construct an explanation based on evidence for how natural selection leads to adaptation of populations. (SEP: 6; DCI: LS4.C ; CCC: Cause/Effect) |
| HS-LS4-5 | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. (SEP: 7; DCI: LS4.C; CCC: Cause/Effect) |
| HS-LS4-6 | Use a simulation to research and analyze possible solutions for the adverse impacts of human activity on biodiversity. (SEP: 5; DCI: LS4.C, LS4.D, ETS1.B; CCC: Cause/Effect) |
| HS-LS4-7 | Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. (SEP: 4; DCI: LS4.A ; CCC: Patterns) |
| HS-ESS3-5 | Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. (SEP: 4; DCI: ESS3.D; CCC: Stability/Change) |
| HS-ESS3-6 | Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. (SEP: 5; DCI: ESS2.D, ESS3.D; CCC: Systems) |

| **High School Chemistry** | |
|---|---|
| HS-PS1-1 | Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. (SEP: 2; DCI: PS1.A, PS2.B; CCC: Patterns) |
| HS-PS1-2 | Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. (SEP: 6; DCI: PS1.A, PS1.B; CCC: Patterns) |
| HS-PS1-3 | Plan and carry out an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (SEP: 3; DCI: PS1.A, PS2.B; CCC: Patterns) |
| HS-PS1-4 | Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. (SEP: 2; DCI: PS1.A, PS1.B; CCC: Energy/Matter) |
| HS-PS1-5 | Construct an explanation based on evidence about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (SEP: 6; DCI: PS1.B; CCC: Patterns) |
| HS-PS1-6 | Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* (SEP: 6; DCI: PS1.B, ETS1.C; CCC: Stability/Change) |
| HS-PS1-7 | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. (SEP: 5; DCI: PS1.B; CCC: Energy/Matter, Nature of |

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| | Science/Consistency) |
| 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. (SEP: 2; DCI: PS1.C; CCC: Energy/Matter) |
| HS-PS2-5 | Plan and carry out 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. (SEP: 3; DCI: PS2.B, PS3.A; CCC: Cause/Effect) |
| HS-PS2-6 | Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* (SEP: 8; DCI: PS1.A, PS2.B; CCC: Structure/Function) |
| 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. (SEP: 5; DCI: PS3.A, PS3.B ; CCC: Systems) |
| HS-PS3-2 | Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). (SEP: 2 ; DCI: PS3.A; CCC: Energy/Matter) |
| 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. (SEP: 6; DCI: PS3.A, PS3.D, ETS1.A; CCC: Energy/Matter, Technology) |
| HS-PS3-4 | Plan and carry out 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). (SEP: 3; DCI: PS3.B, PS3.D; CCC: Systems) |
| 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. (SEP: 2; DCI: ESS1.A, PS3.D; CCC: Scale/Prop.) |
| 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. (SEP: 6; DCI: PS4.B, ESS1.A; CCC: Energy/Matter, Technology) |
| HS-ESS1-3 | Communicate scientific ideas about the way stars, over their life cycle, produce elements. (SEP: 8; DCI: ESS1.A; CCC: Energy/Matter) |
| 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. (SEP: 6; DCI: ESS3.A, ESS3.B ; CCC: Cause/Effect, Technology) |
| HS-ESS3-2 | Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* (SEP: 7; DCI: ESS3.A, ETS1.B; CCC: Technology) |
| HS-ESS3-3 | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. (SEP: 5; DCI: ESS3.C; CCC: Stability/Change, Technology) |
| HS-ESS3-4 | Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* (SEP: 6; DCI: ESS3.C, ETS1.B; CCC: Stability/Change, Technology) |

| **High School Physics** | |
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| HS-PS1-3 | Plan and carry out an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (SEP: 3; DCI: PS1.A, PS2.B; CCC: Patterns) |
| 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. (SEP: 4; DCI: PS2.A; CCC: Cause/Effect ) |

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| 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. (SEP: 5; DCI: PS2.A ; CCC: Systems) |
| HS-PS2-3 | Design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* (SEP: 6; DCI: PS2.A, ETS1.A, ETS1.C; CCC: Cause/Effect ) |
| 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. (SEP: 5; DCI: PS2.B; CCC: Patterns) |
| HS-PS2-5 | Plan and carry out 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. (SEP: 3; DCI: PS2.B, PS3.A; CCC: Cause/Effect) |
| HS-PS2-6 | Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* (SEP: 8; DCI: PS1.A, PS2.B; CCC: Structure/Function) |
| 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. (SEP: 5; DCI: PS3.A, PS3.B ; CCC: Systems) |
| HS-PS3-4 | Plan and carry out 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). (SEP: 3; DCI: PS3.B, PS3.D; CCC: Systems) |
| 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. (SEP: 2; DCI: PS3.C; CCC: Cause/Effect) |
| HS-PS4-1 | Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. (SEP: 5; DCI: PS4.A; CCC: Cause/Effect) |
| HS-PS4-2 | Evaluate questions about the advantages of using a digital transmission and storage of information. (SEP: 1; DCI: PS4.A; CCC: Stability/Change, Technology) |
| 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. (SEP: 7; DCI: PS4.A, PS4.B; CCC: Systems) |
| 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. (SEP: 8; DCI: PS4.B; CCC: Cause/Effect) |
| 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.* (SEP: 8; DCI: PS3.D, PS4.A, PS4.B, PS4.C; CCC: Cause/Effect, Technology) |
| HS-ESS1-4 | Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (SEP: 5; DCI: ESS1.B; CCC: Scale/Prop., Technology) |
| 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. (SEP: 7; DCI: ESS1.C, ESS2.B, PS1.C; CCC: Patterns) |
| 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. (SEP: 6; DCI: ESS1.C, PS1.C; CCC: Stability/Change) |
| HS-ESS2-1 | Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems. (SEP: 2; DCI: ESS2.A, ESS2.B; CCC: Stability/Change) |
| HS-ESS2-2 | Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. (SEP: 4; DCI: ESS2.A, ESS2.D; CCC: Stability/Change, Technology) |
| HS-ESS2- | Use a model to describe how variations in the flow of energy into and out of Earth's systems result |

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| 3 | in changes in climate. (SEP: 2; DCI: ESS2.A, ESS2.B, PS4.A; CCC: Energy/Matter, Technology) |
| HS-ESS2-4 | Plan and carry out an investigation of the properties of water and its effects on Earth materials and surface processes. (SEP: 2; DCI: ESS1.B, ESS2.A, ESS2.D; CCC: Cause/Effect) |