**High School Integrated Science Course 1**

The 9th grade high school science course, based on an integrated grouping of Next Generation Science Standards will introduce students to the following concepts (arranged topically)[[1]](#footnote-1):

**Physical Science**

### [Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

* [Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [Types of Interactions](http://www.nextgenscience.org/%3Ca)

* [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. (secondary to HS-PS1-1),(secondary to HS-PS1-3),(HS-PS2-6)](http://www.nextgenscience.org/%3Ca)

### [Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

* [A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

* [Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)](http://www.nap.edu/openbook.php?record_id=13165&page=109)
* [In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)](http://www.nap.edu/openbook.php?record_id=13165&page=109)
* [The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)](http://www.nap.edu/openbook.php?record_id=13165&page=109)

### [Forces and Motion](http://www.nap.edu/openbook.php?record_id=13165&page=114)

* [Newton’s second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)](http://www.nap.edu/openbook.php?record_id=13165&page=114)
* [Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)](http://www.nap.edu/openbook.php?record_id=13165&page=114)
* [If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)](http://www.nap.edu/openbook.php?record_id=13165&page=114)

### [Types of Interactions](http://www.nap.edu/openbook.php?record_id=13165&page=116)

* [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. (HS-PS2-4)](http://www.nap.edu/openbook.php?record_id=13165&page=116)
* [Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)](http://www.nap.edu/openbook.php?record_id=13165&page=116)

### [Definitions of Energy](http://www.nap.edu/openbook.php?record_id=13165&page=120)

* [“Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [Energy in Chemical Processes](http://www.nap.edu/openbook.php?record_id=13165&page=128)

* [Solar cells are human-made devices that likewise capture the sun’s energy and produce electrical energy. (secondary to HS-PS4-5)](http://www.nap.edu/openbook.php?record_id=13165&page=128)

### [Wave Properties](http://www.nap.edu/openbook.php?record_id=13165&page=131)

* [The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)](http://www.nap.edu/openbook.php?record_id=13165&page=131)
* [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. (HS-PS4-2),(HS-PS4-5)](http://www.nap.edu/openbook.php?record_id=13165&page=131)
* [[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.) (HS-PS4-3)](http://www.nap.edu/openbook.php?record_id=13165&page=131)

### [Electromagnetic Radiation](http://www.nap.edu/openbook.php?record_id=13165&page=133)

* [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. (HS-PS4-3)](http://www.nap.edu/openbook.php?record_id=13165&page=133)
* [Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)](http://www.nap.edu/openbook.php?record_id=13165&page=133)

### [Information Technologies and Instrumentation](http://www.nap.edu/openbook.php?record_id=13165&page=136)

* [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. (HS-PS4-5)](http://www.nap.edu/openbook.php?record_id=13165&page=136)

### [Definitions of Energy](http://www.nap.edu/openbook.php?record_id=13165&page=120)

* [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. (HS-PS3-1),(HS-PS3-2)](http://www.nap.edu/openbook.php?record_id=13165&page=120)
* [At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)](http://www.nap.edu/openbook.php?record_id=13165&page=120)
* [These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [Conservation of Energy and Energy Transfer](http://www.nap.edu/openbook.php?record_id=13165&page=124)

* [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. (HS-PS3-1)](http://www.nap.edu/openbook.php?record_id=13165&page=124)
* [Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)](http://www.nap.edu/openbook.php?record_id=13165&page=124)
* [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. (HS-PS3-1)](http://www.nap.edu/openbook.php?record_id=13165&page=124)
* [The availability of energy limits what can occur in any system. (HS-PS3-1)](http://www.nap.edu/openbook.php?record_id=13165&page=124)
* [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). (HS-PS3-4)](http://www.nap.edu/openbook.php?record_id=13165&page=124)

### [Energy in Chemical Processes](http://www.nap.edu/openbook.php?record_id=13165&page=128)

* [Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4)](http://www.nap.edu/openbook.php?record_id=13165&page=128)

**Life Science**

### [Interdependent Relationships in Ecosystems](http://www.nap.edu/openbook.php?record_id=13165&page=150)

* [Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2)](http://www.nap.edu/openbook.php?record_id=13165&page=150)

### [Ecosystem Dynamics, Functioning, and Resilience](http://www.nap.edu/openbook.php?record_id=13165&page=154)

* [A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)](http://www.nap.edu/openbook.php?record_id=13165&page=154)

**Earth Science**

### [Earth and the Solar System](http://www.nap.edu/openbook.php?record_id=13165&page=175)

* [Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)](http://www.nap.edu/openbook.php?record_id=13165&page=175)

### [Earth Materials and Systems](http://www.nap.edu/openbook.php?record_id=13165&page=179)

* [Earth’s systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.)](http://www.nap.edu/openbook.php?record_id=13165&page=179)

### [Plate Tectonics and Large-Scale System Interactions](http://www.nap.edu/openbook.php?record_id=13165&page=182)

* [Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth’s surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) (secondary to HS-ESS1-5),(HS-ESS2-1)](http://www.nap.edu/openbook.php?record_id=13165&page=182)
* [Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth’s crust. (ESS2.B Grade 8 GBE) (HS-ESS2-1)](http://www.nap.edu/openbook.php?record_id=13165&page=182)

**[Nuclear Processes](http://www.nap.edu/openbook.php?record_id=13165&page=111)**

* [Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6)](http://www.nap.edu/openbook.php?record_id=13165&page=111)

### [Earth Materials and Systems](http://www.nap.edu/openbook.php?record_id=13165&page=179)

* [Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth’s surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth’s interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)](http://www.nap.edu/openbook.php?record_id=13165&page=179)

### [Plate Tectonics and Large-Scale System Interactions](http://www.nap.edu/openbook.php?record_id=13165&page=182)

* [The radioactive decay of unstable isotopes continually generates new energy within Earth’s crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)](http://www.nap.edu/openbook.php?record_id=13165&page=182)

### [The Roles of Water in Earth's Surface Processes](http://www.nap.edu/openbook.php?record_id=13165&page=184)

* [The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water’s exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)](http://www.nap.edu/openbook.php?record_id=13165&page=184)

### [Earth and the Solar System](http://www.nap.edu/openbook.php?record_id=13165&page=175)

* [Cyclical changes in the shape of Earth’s orbit around the sun, together with changes in the tilt of the planet’s axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)](http://www.nap.edu/openbook.php?record_id=13165&page=175)

[**Earth Materials and Systems**](http://www.nap.edu/openbook.php?record_id=13165&page=179)

* [The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)](http://www.nap.edu/openbook.php?record_id=13165&page=179)

### [Weather and Climate](http://www.nap.edu/openbook.php?record_id=13165&page=186)

* [The foundation for Earth’s global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy’s re-radiation into space. (HS-ESS2-4)](http://www.nap.edu/openbook.php?record_id=13165&page=186)
* [Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)](http://www.nap.edu/openbook.php?record_id=13165&page=186)

### [Natural Resources](http://www.nap.edu/openbook.php?record_id=13165&page=191)

* [All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)](http://www.nap.edu/openbook.php?record_id=13165&page=191)

### [Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=175)

* [When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary HS-ESS3-4)](http://www.nap.edu/openbook.php?record_id=13165&page=206)

**Engineering and Design**

### [Defining and Delimiting Engineering Problems](http://www.nap.edu/openbook.php?record_id=13165&page=204)

* [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. (HS-ETS1-1,](http://www.nap.edu/openbook.php?record_id=13165&page=204) secondary to HS-PS3-3)
* [When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [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. (HS-ETS1-4)](http://www.nap.edu/openbook.php?record_id=13165&page=206)

### [Optimizing the Design Solution](http://www.nap.edu/openbook.php?record_id=13165&page=208)

* [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. (HS-ETS1-2) (secondary to HS-PS2-3 and HS-PS1-6)](http://www.nap.edu/openbook.php?record_id=13165&page=208)

**[Physical Science Components](http://www.nap.edu/openbook.php?record_id=13165&page=208)**

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| [**[HS.SPM](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [Structure, Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hsps-spm-structure-properties-matter) [🡨 Note: This is a ‘](http://www.nap.edu/openbook.php?record_id=13165&page=208)[[Topic Arrangement’](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/sites/ngss/files/NGSS%20Combined%20Topics%2011.8.13.pdf) [term](http://www.nap.edu/openbook.php?record_id=13165&page=208) **[[](http://www.nap.edu/openbook.php?record_id=13165&page=208)**[HS-PS1-8. 🡪 Course 3]](http://www.nap.edu/openbook.php?record_id=13165&page=208) | | |
| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-1-matter-and-its-interactions) | [Matter and its Interactions [periodic table]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [PCI](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-3](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-3-matter-and-its-interactions) | [Matter and its Interactions [electrical forces between particles]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [OECI](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-6](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-6-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [molecular-level structure]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS4-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps4-1-waves-and-their-applications-technologies-information-transfer) | [Waves and their Applications in Technologies for Information Transfer [f,](http://www.nap.edu/openbook.php?record_id=13165&page=208) **[λ](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [& v of waves]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [AQDP](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS4-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps4-2-waves-and-their-applications-technologies-information-transfer) | [Waves and their Applications in Technologies for Information Transfer [digital information]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [EAE](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS4-3](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps4-3-waves-and-their-applications-technologies-information-transfer) | [Waves and their Applications in Technologies for Information Transfer [EMR model]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [OECE](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS4-5](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps4-waves-and-their-applications-technologies-information-transfer-0) | [Waves and their Applications in Technologies for Information Transfer [Technological devices]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [**[HS.CR](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hsps-cr-chemical-reactions) | | |
| [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-2-matter-and-its-interactions) | [Matter and its Interactions [chemical reaction based on the outermost electron states]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-4-matter-and-its-interactions) | [Matter and its Interactions [release or absorption of energy from a chemical reaction system]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-5](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-5-matter-and-its-interactions) | [Matter and its Interactions [rate at which a reaction occurs]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-6](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-6-matter-and-its-interactions) | [Matter and its Interactions [chemical system and products at equilibrium]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS1-7](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps1-7-matter-and-its-interactions) | [Matter and its Interactions [conservation of mass during a chemical reaction]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [AIR](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-1-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [Newton’s second law of motion]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-2-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [Conservation of momentum]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-3](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-3-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [forces on macroscopic objects during collisions]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-4-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [Newton’s Law of Gravitation and Coulomb’s Law]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [PCI](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS2-5](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps2-5-motion-and-stability-forces-and-interactions) | [Motion and Stability: Forces and Interactions [electric currents and magnetic fields]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [[Science and Engineering Practices:](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=41) | | | |
| [[PCI:](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=59) | [Plan and carry out investigations](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=67)[:](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Constructing explanations and designing solutions](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [[DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=56)[:](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Develop and use models](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[AQDP](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=54)[:](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Ask questions and define problems](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [[EAE:](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=71) | [Engage in arguments from Evidence](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[AID](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=61)[:](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Analyzing and interpreting data](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [[OECE:](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=59) | [Obtain, evaluate, and communicating evidence](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nap.edu/openbook.php?record_id=13165&page=64)[:](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Using mathematics and computational thinking](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-LS2-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ls2-1-ecosystems-interactions-energy-and-dynamics) | [Ecosystems: Interactions, Energy, and Dynamics [factors that affect ecosystem carrying capacity]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-LS2-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ls2-2-ecosystems-interactions-energy-and-dynamics) | [Ecosystems: Interactions, Energy, and Dynamics [factors affecting biodiversity and populations]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [EAE](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS3-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess3-2-earth-and-human-activity)[\*](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [Earth and Human Activity [Managing mineral resources] \*Added to this topic arrangement](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS3-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps3-1-energy) | [Energy [energy ∆ and energy flow in systems]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS3-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps3-2-energy) | [Energy [energy @ macroscopic scales is = motion and relative positions of particles (objects).]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS3-3](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps3-3-energy) | [Energy [energy conversion one form of energy into another form of energy.]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [PCI](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-PS3-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ps3-4-energy) | [Energy [closed system energy distribution (second law of thermodynamics)]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS1-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess1-4-earths-place-universe) | [Earth's Place in the Universe [Predicting the orbiting of objects in the solar system]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [**[HS.HE](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [History of Earth](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hsess-he-history-earth) **[[](http://www.nap.edu/openbook.php?record_id=13165&page=208)**[HS-ESS1-6 🡪 Course 3]](http://www.nap.edu/openbook.php?record_id=13165&page=208) | | | |
| [EAE](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS1-5](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess1-5-earths-place-universe) | [Earth's Place in the Universe [oceanic crust and the theory of plate tectonics, rock age]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS2-1](http://www.nap.edu/openbook.php?record_id=13165&page=208)](Earth%E2%80%99s%20internal%20and%20surface%20processes) | [Earth's Systems [Earth’s internal and surface processes]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS2-3](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess2-3-earths-systems) | [Earth's Systems [Earth’s interior, cycling of matter by thermal convection]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |
| [PCI](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS2-5](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess2-5-earths-systems) | [Earth's Systems [Water’s effect on Earth materials and surface processes]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS2-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess2-4-earths-systems) | [Earth's Systems [Flow of energy into and out of Earth’s systems result in changes in climate.]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [**[HS.HS](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [Human Sustainability](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hsess-hs-human-sustainability) **[[](http://www.nap.edu/openbook.php?record_id=13165&page=208)** [HS-ESS3-1, 3 🡪 Course 3 ]](http://www.nap.edu/openbook.php?record_id=13165&page=208) | | |
| [EAE](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ESS3-2](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ess3-2-earth-and-human-activity) | [Earth and Human Activity [Developing, managing, and utilizing energy and mineral resources]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

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| [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=208) | [[HS-ETS1-4](http://www.nap.edu/openbook.php?record_id=13165&page=208)](http://www.nextgenscience.org/hs-ets1-4-engineering-design) | [Engineering Design [Use computer simulation to model the impact of proposed solutions]](http://www.nap.edu/openbook.php?record_id=13165&page=208) |

1. Note: In this original ‘draft’ form (.doc), many of the items cited above are hyperlinked to the NGSS website [<http://www.nextgenscience.org/>] and to its supporting framework [[A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas ( 2012 )](http://www.nap.edu/catalog.php?record_id=13165) ]. [↑](#footnote-ref-1)