South Dakota Science

High School Science (Grades 9-12)

Physical Science PS

1 Matter and Its Interactions 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-PS1-1

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-PS1-2

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-PS1-3

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-PS1-4

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-PS1-5

6 Refine the design of a chemical reaction 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) Alignment may include HS-ETS1-3 HS-PS1-6

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 Science/Consistency) HS-PS1-7

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-PS1-8

2 Motion and Stability: Forces and Interactions 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) HS-PS2-1

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-PS2-2

Skip to main content

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) Alignment may include HS-ETS1-1, HS-ETS1-3 HS-PS2-3

4 a) Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects; and b) Use mathematical representations of Coulomb's Law to describe and predict electrostatic force between objects. (SEP: 5; DCI: PS2.B; CCC: Patterns) HS-PS2-4

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-PS2-5

6 Communicate scientific and technical information about why the molecular-level structure (intermolecular forces) is important in the functioning of designed materials. (SEP: 8; DCI: PS1.A, PS2.B, ETS1.A; CCC: Structure/Function) Alignment may include HS-ETS1-1 HS-PS2-6

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3 Energy 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-PS3-1

2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion and relative position of particles (objects). (SEP: 2; DCI: PS3.A; CCC: Energy/Matter) HS-PS3-2

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) Alignment may include HS-ETS1-2 HS-PS3-3

4 Plan and carry out an investigation to provide evidence for the Second Law of Thermodynamics. (SEP: 3; DCI: PS3.B, PS3.D; CCC: Systems) HS-PS3-4

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-PS3-5

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4 Waves and Their Applications in Technologies for Information Transfer 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-PS4-1

2 Evaluate questions about the advantages of using a digital transmission and storage of information. (SEP: 1; DCI: PS4.A; CCC: Stability/Change) Alignment may include HS-ETS1-1 HS-PS4-2

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-PS4-3

Skip to main content

4 Engage in an evidence-based argument for the effects that different frequencies of electromagnetic radiation have when absorbed by matter. (SEP: 7; DCI: PS4.B; CCC: Cause/Effect) HS-PS4-4

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, ETS1.A; CCC: Cause/Effect) Alignment may include HS-ETS1-1 HS-PS4-5

Life Science LS

1 From Molecules to Organisms: Structures and Processes LS1

1 Construct an evidence-based explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells, tissues, and organs. (SEP: 6; DCI: LS1.A; CCC: Structure/Function) HS-LS1-1

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-LS1-2

3 Plan and carry out an investigation to provide evidence that feedback mechanisms maintain homeostasis. (SEP: 3; DCI: LS1.A; CCC: Stability/Change) HS-LS1-3

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-LS1-4

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-LS1-5

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-LS1-6

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-LS1-7

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2 Ecosystems: Interactions, Energy, and Dynamics 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-LS2-1

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-LS2-2

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-LS2-3

Skip to main content

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-LS2-4

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-LS2-5

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-LS2-6

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, ETS1.C; CCC: Stability/Change) Alignment may include HS-ETS1-2 and HS-ETS1-3 HS-LS2-7

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-LS2-8

3 Heredity: Inheritance and Variation of Traits 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-LS3-1

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-LS3-2

3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (SEP: 4; DCI: LS3.B; CCC: Scale/Prop.) HS-LS3-3

4 Biological Unity and Diversity 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-LS4-1

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-LS4-2

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-LS4-3

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-LS4-4

Skip to main content

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-LS4-5

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) Alignment may include HS-ETS1-3, HS-ETS1-4 HS-LS4-6

Earth and Space Science ESS

1 Earth's Place in the Universe 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-ESS1-1

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) HS-ESS1-2

3 Communicate scientific ideas about the way stars, over their life cycle, produce elements. (SEP: 8; DCI: ESS1.A; CCC: Energy/Matter) HS-ESS1-3

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.) HS-ESS1-4

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-ESS1-5

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-ESS1-6

2 Earth's Systems 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. (SEP:2; DCI: ESS2.B; CCC: Stability/Change) HS-ESS2-1

2 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

3 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) HS-ESS2-3

4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. (SEP: 2; DCI: ESS2.A, ESS2.B, PS4.A; CCC: Energy/Matter) HS-ESS2-4

5 Plan and carry out an investigation of the properties of water and its effects on Earth's materials and surface processes. (SEP: 2; DCI: ESS1.B, ESS2.A, ESS2.D; CCC: Cause/Effect) HS-ESS2-5

Skip to main content

3 Earth and Human Activity 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) HS-ESS3-1
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: Energy and Matter) Alignment may include HS-ETS1-3 HS-ESS3-2
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) HS-ESS3-3
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) Alignment may include HS-ETS1-3 HS-ESS3-4
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-ESS3-5
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) HS-ESS3-6

Engineering, Technology, and Applications of Science ETS

1 Engineering Design ETS1

1. Analyze a major global challenge to specify qualitative and quantitative criteria for constraints for solutions that account for societal needs and wants. Alignment may include HS-PS2-3; HS-PS2-6; HS-PS4-2; HS-PS4-5 HS-ETS1-1
2. Design a solution to complex real-world problems by breaking it down into smaller, more manageable problems that can be solved through engineering. Alignment may include HS-LS2-7; HS-PS3-3 HS-ETS1-2
3. Evaluate a solution to a complex real-word problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as social, cultural, and environmental impacts. Alignment may include HS-PS1-6; HS-PS2-3; HS-LS2-7; HS-LS4-6; HS-ESS3-2; HS-ESS3-4 HS-ETS1-3
4. Use a computer simulation to model the impact of proposed solutions to a complex realworld problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Alignment may include HS-LS4-6 HS-ETS1-4