Oklahoma Science

Grades 9, 10, 11, 12

Adopted 2020

Physical Science

Matter and Its Interactions

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. PS.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, knowledge of the patterns of chemical properties, and formation of compounds. PS.PS1.2
5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. PS.PS1.5
7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. PS.PS1.7

Motion and Stability: Forces and Interactions

1. Analyze and interpret data to support the claim of a causal relationship between the net force on an object and its change in motion, as described in Newton's second law of motion. PS.PS2.1
2. Use mathematical representations to support the explanation that the total momentum of a system of objects is conserved when there is no net force on the system. PS.PS2.2
3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. PS.PS2.3
5. Plan and conduct an investigation to provide evidence that an electric current can cause a magnetic field and that a changing magnetic field can cause an electric current. PS.PS2.5

Energy

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. PS.PS3.1
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. PS.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. PS.PS3.3
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). PS.PS3.4

Waves and Their Applications in Technologies for Information Transfer

1. Use mathematical representations to explain both qualitative and quantitative relationships among frequency, wavelength, and speed of waves traveling in various media. PS.PS4.1
2. Evaluate questions about the advantages and disadvantages of using a digital transmission and storage of information. PS.PS4.2
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. PS.PS4.4

Chemistry

Matter and Its Interactions

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. CH.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, knowledge of the patterns of chemical properties, and formation of compounds. CH.PS1.2
3. Plan and conduct an investigation to compare the structure of substances at the bulk scale level to infer the strength of electrical forces between particles. CH.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. CH.PS1.4
5. Apply scientific principles and evidence to provide an explanation about the effects of changing the conditions of the reacting particles on the rate at which a reaction occurs. CH.PS1.5
6. Refine the design of a chemical system by specifying a change in conditions that would produce a change in the amounts of products at equilibrium. CH.PS1.6
7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. CH.PS1.7
8. Develop models to illustrate the changes in composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. CH.PS1.8

Motion Stability: Forces and Interactions

6. Communicate scientific and technical information about why the molecular level structure of designed materials determines how the material functions. CH.PS2.6

Energy

3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. CH.PS3.3
4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy between components in a closed system involves changes in energy dispersal and heat content and results in a more uniform energy distribution among the components in the system (second law of thermodynamics). CH.PS3.4

Waves and Their Applications in Technologies for Information Transfer

1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. CH.PS4.1
3. Develop an argument for how scientific evidence supports the explanation that electromagnetic radiation can be described either by the wave model or the particle model, and in some situations one model is more useful than the other. CH.PS4.3

Physics

Matter and Its Interactions

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. PH.PS1.8

1. Analyze and interpret 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. PH.PS2.1

Motion and Stability: Forces and Interactions

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. PH.PS2.2
3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. PH.PS2.3
4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between object. PH.PS2.4
5. Plan and conduct an investigation to provide evidence that an electric current can cause a magnetic field and that a changing magnetic field can cause an electric current. PH.PS2.5

Energy

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. PH.PS3.1
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. PH.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. PH.PS3.3
4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy between components in a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). PH.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. PH.PS3.5

Waves and Their Applications in Technologies for Information Transfer

1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. PH.PS4.1
2. Evaluate questions about the advantages and disadvantages of using digital transmission and storage of information. PH.PS4.2
3. Develop an argument for how scientific evidence supports the explanation that electromagnetic radiation can be described either by the wave model or the particle model, and in some situations one model is more useful than the other. PH.PS4.3
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. PH.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. PH.PS4.5

Biology

From Molecules to Organisms: Structures and Processes

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. B.LS1.1
2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. B.LS1.2
3. Plan and conduct an investigation to provide evidence of the importance of maintaining homeostasis in living organisms. B.LS1.3
4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. B.LS1.4
5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. B.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. B.LS1.6
7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. B.LS1.7

Ecosystems: Interactions, Energy, and Dynamics

1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacities of ecosystems at different scales. B.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. B.LS2.2
3. Construct and revise an explanation based on evidence for the cycling of matter and the flow of energy in aerobic and anaerobic conditions. B.LS2.3
4. Use a mathematical representation to support claims for the cycling of matter and the flow of energy among organisms in an ecosystem. B.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. B.LS2.5
6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. B.LS2.6
8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce. B.LS2.8

Heredity: Inheritance and Variation of Traits

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. B.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. B.LS3.2
3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. B.LS3.3

Biological Unity and Diversity

1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. B.LS4.1
2. Construct an explanation based on evidence that biological diversity is influenced by (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. B.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. B.LS4.3
4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. B.LS4.4
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. B.LS4.5

Earth And Space Science

Earth's Place in the Universe

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 convert matter to energy that eventually reaches Earth in the form of radiation. ES.ESS1.1
2. Construct an explanation of how the universe formed as a single point and continues to expand based on astronomical evidence of light spectra, motion of distant galaxies, and the composition of matter in the universe. ES.ESS1.2
3. Construct an explanation about the process that causes stars to produce elements throughout their life cycle. ES.ESS1.3
4. Use mathematical or computational representations to determine patterns that can be used to predict the motion of orbiting objects in the solar system. ES.ESS1.4
5. Evaluate evidence in the patterns of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. ES.ESS1.5
6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of changes in Earth's formation and early history. ES.ESS1.6

Earth Systems

1. Develop a model to illustrate how Earth's internal and surface processes operate at different scales of space and time to form continental and ocean-floor features. ES.ESS2.1
2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks and interactions that cause changes to other Earth's systems. ES.ESS2.2
3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. ES.ESS2.3
4. Analyze and interpret data to explore how variations in the flow of energy into and out of Earth's systems causes changes to the atmosphere and climate. ES.ESS2.4
5. Plan and conduct investigations of how the structure and resulting properties of water interact with the Earth's materials and surface processes. ES.ESS2.5
6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. ES.ESS2.6
7. Engage in argument from evidence for how the simultaneous co-evolution of Earth's systems and life on Earth led to periods of stability and change over geologic time. ES.ESS2.7

Earth and Human Activities

1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate effect human activity. ES.ESS3.1
2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost benefit ratios on large and small scales. ES.ESS3.2
5. Construct a scientific explanation from evidence for how geological processes cause uneven distribution of natural resources. ES.ESS3.5

Environmental Science

Ecosystems: Interactions, Energy, and Dynamics

1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacities of ecosystems at different scales. EN.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. EN.LS2.2
4. Use a mathematical representation to support claims for the cycling of matter and the flow of energy among organisms in an ecosystem. EN.LS2.4
6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. EN.LS2.6
7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. EN.LS2.7

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Earth and Human Activities

1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate effect human activity. EN.ESS3.1
2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost benefit ratios on large and small scales. EN.ESS3.2
3. Use computational simulations to illustrate changes between the relationships of natural resources, human populations, and biodiversity and their sustainability within Earth systems. EN.ESS3.3
4. Evaluate design solutions for a major global or local environmental problem that reduces or stabilizes the impacts of human activities on natural systems. EN.ESS3.4