Arizona Science

# Grades 9, 10, 11, 12

Adopted 2018

## High School Chemistry

### Structures and Properties of Matter

1. Develop and use models to explain the relationship of the structure of atoms to patterns and properties observed in the Periodic Table and describe how these models are revised with new evidence. HS.P1U1.1

1. Develop and use models to demonstrate how changes in the number of subatomic particles (protons, neutrons, electrons) affect the identity, stability, and properties of the element. HS+C.P1U1.1

2. Obtain, evaluate, and communicate the qualitative evidence supporting claims about how atoms absorb and emit energy in the form of electromagnetic radiation. HS+C.P1U1.2

3. Analyze and interpret data to develop and support an explanation for the relationships between kinetic molecular theory and gas laws. HS+C.P1U1.3

### Chemical Reactions

2. Develop and use models for the transfer or sharing of electrons to predict the formation of ions, molecules, and compounds in both natural and synthetic processes. HS.P1U1.2

3. Ask questions, plan, and carry out investigations to explore the cause and effect relationship between reaction rate factors. HS.P1U1.3

4. Develop and use models to predict and explain forces within and between molecules. HS+C.P1U1.4

5. Plan and carry out investigations to test predictions of the outcomes of various reactions, based on patterns of physical and chemical properties. HS+C.P1U1.5

6. Construct an explanation, design a solution, or refine the design of a chemical system in equilibrium to maximize production. HS+C.P1U1.6

7. Use mathematics and computational thinking to determine stoichiometric relationships between reactants and products in chemical reactions. HS+C.P1U1.7

### Nuclear Processes and Applications of Chemistry

4. Obtain, evaluate, and communicate information about how the use of chemistry related technologies have had positive and negative ethical, social, economic, and/or political implications. HS.P1U3.4

8. Engage in argument from evidence regarding the ethical, social, economic, and/or political benefits and liabilities of fission, fusion, and radioactive decay. HS+C.P1U3.8

**High School Physics**

### Motion & Stability – Forces & Interactions

5. Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic). HS.P2U1.5
6. Collect, analyze and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws. HS.P3U1.6
7. Use mathematics and computational thinking to explain how Newton's laws are used in engineering and technologies to create products to serve human ends. HS.P3U2.7
1. Plan and carry out investigations to design, build, and refine a device that works within given constraints to demonstrate that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS+PHY.P2U1.1
2. Develop and use mathematical models of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. HS+PHY.P3U1.2
3. Develop a mathematical model, using Newton's laws, to predict the motion of an object or system in two dimensions (projectile and circular motion). HS+PHY.P3U1.3
4. Engage in argument from evidence regarding the claim that the total momentum of a system is conserved when there is no net force on the system. HS+PHY.P3U1.4
5. Design, evaluate, and refine a device that minimizes or maximizes the force on a macroscopic object during a collision. HS+PHY.P3U2.5

### Energy & Waves

8. Engage in argument from evidence that the net change of energy in a system is always equal to the total energy exchanged between the system and the surroundings. HS.P4U1.8
9. Engage in argument from evidence regarding the ethical, social, economic, and/or political benefits and liabilities of energy usage and transfer. HS.P4U3.9
10. Construct an explanation about the relationships among the frequency, wavelength, and speed of waves traveling in various media, and their applications to modern technology. HS.P4U1.10
6. Analyze and interpret data to quantitatively describe changes in energy within a system and/or energy flows in and out of a system. HS+PHY.P4U1.6
7. Design, evaluate, and refine a device that works within given constraints to transfer energy within a system. HS+PHY.P4U2.7
8. Use mathematics and computational thinking to explain the relationships between power, current, voltage, and resistance. HS+PHY.P4U1.8

**High School Earth and Space Sciences**

### Weather & Climate

11. Analyze and interpret data to determine how energy from the Sun affects weather patterns and climate. HS.E1U1.11

1. Construct an explanation based on evidence for how the Sun's energy transfers between Earth's systems. HS+E.E1U1.1
2. Develop and use models to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. HS+E.E1U1.2
3. Analyze geoscience data and the results from global climate models to make evidence-based predictions of current rate and scale of global or regional climate changes. HS+E.E1U1.3

### Roles of Water in Earth's Surface Processes

12. Develop and use models of the Earth that explains the role of energy and matter in Earth's constantly changing internal and external systems (geosphere, hydrosphere, atmosphere, biosphere). HS.E1U1.12
4. Analyze and interpret geoscience data to make the claim that dynamic interactions with Earth's surface can create feedbacks that cause changes to other Earth systems. HS+E.E1U1.4
5. Obtain, evaluate, and communicate information on the effect of water on Earth's materials, surface processes, and groundwater systems. HS+E.E1U1.5

### Earth's Systems

13. Evaluate explanations and theories about the role of energy and matter in geologic changes over time. HS.E1U1.13
6. Obtain, evaluate, and communicate information of the theory of plate tectonics to explain the differences in age, structure, and composition of Earth's crust. HS+E.E1U1.6
7. Engage in argument from evidence of ancient Earth materials, meteorites, and other planetary surfaces to explain Earth's formation and early history. HS+E.E1U1.7
8. Develop and use models to illustrate how Earth's internal and surface processes operate over time to form, modify, and recycle continental and ocean floor features. HS+E.E1U1.8

**Earth and Human Activity**

14. Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other. HS.E1U3.14

9. 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. HS+E.E1U3.9

10. Ask questions, define problems, and evaluate a solution to a complex problem, based on prioritized criteria and tradeoffs, that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS+E.E1U3.10

11. Develop and use a quantitative model to illustrate the relationship among Earth systems and the degree to which those relationships are being modified due to human activity. HS+E.E1U3.11

**Earth's Place in the Universe**

15. Construct an explanation based on evidence to illustrate the role of nuclear fusion in the life cycle of a star. HS.E2U1.15

12. Obtain, evaluate, and communicate scientific information about the way stars, throughout their stellar stages, produce elements and energy. HS+E.E2U1.12

**Earth and the Solar System**

16. Construct an explanation of how gravitational forces impact the evolution of planetary motion, structure, surfaces, atmospheres, moons, and rings. HS.E2U1.16

13. Analyze and interpret data showing how gravitational forces are influenced by mass, and the distance between objects. HS+E.E2U1.13

14. Use mathematics and computational thinking to explain the movement of planets and objects in the solar system. HS+E.E2U1.14

**The Universe and its Stars**

17. Construct an explanation of the origin, expansion, and scale of the universe based on astronomical evidence. HS.E2U1.17

15. Obtain, evaluate, and communicate information on how the nebular theory explains solar system formation with distinct regions characterized by different types of planetary and other bodies. HS+E.E2U1.15

16. Obtain, evaluate, and communicate information about patterns of size and scale of our solar system, our galaxy, and the universe. HS+E.E2U1.16

17. Obtain, evaluate, and communicate the impact of technology on human understanding of the formation, scale, and composition of the universe. HS+E.E2U2.17

**High School Life Sciences**

### Ecosystems

18. Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem. HS.L2U3.18
19. Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment. HS.L2U1.19

1. Develop a model showing the relationship between limiting factors and carrying capacity, and use the model to make predictions on how environmental changes impact biodiversity. HS+B.L2U1.1
2. Engage in argument from evidence that changes in environmental conditions or human interventions may change species diversity in an ecosystem. HS+B.L4U1.2
3. Use mathematics and computational thinking to support claims for the cycling of matter and flow of energy through trophic levels in an ecosystem. HS+B.L2U1.3

### Cells & Organisms

20. Ask questions and/or make predictions based on observations and evidence to demonstrate how cellular organization, structure, and function allow organisms to maintain homeostasis. HS.L1U1.20
21. Obtain, evaluate, and communicate data showing the relationship of photosynthesis and cellular respiration; flow of energy and cycling of matter. HS.L2U1.21
22. Construct an explanation for how cellular division (mitosis) is the process by which organisms grow and maintain complex, interconnected systems. HS.L1U1.22
23. Obtain, evaluate, and communicate the ethical, social, economic and/or political implications of the detection and treatment of abnormal cell function. HS.L1U3.23

4. Develop and use models to explain the interdependency and interactions between cellular organelles. HS+B.L1U1.4
5. Analyze and interpret data that demonstrates the relationship between cellular function and the diversity of protein functions. HS+B.L1U1.5
6. Develop and use models to show how transport mechanisms function in cells. HS+B.L1U1.6
7. Develop and use models to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms (plant and animal). HS+B.L1U1.7
8. Develop and use models to develop a scientific explanation that illustrates how photosynthesis transforms light energy into stored chemical energy and how cellular respiration breaks down macromolecules for use in metabolic processes. HS+B.L2U1.8
9. Develop and use a model to communicate how a cell copies genetic information to make new cells during asexual reproduction (mitosis). HS+B.L1U1.9

### Genetics

24. Construct an explanation of how the process of sexual reproduction contributes to genetic variation. HS.L3U1.24
25. Obtain, evaluate, and communicate information about the causes and implications of DNA mutation. HS.L3U1.25
26. Engage in argument from evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology. HS.L3U3.26
10. Use mathematics and computational thinking to explain the variation that occurs through meiosis and calculate the distribution of expressed traits in a population. HS+B.L3U1.10
11. Construct an explanation for how the structure of DNA and RNA determine the structure of proteins that perform essential life functions. HS+B.L3U1.11
12. Analyze and interpret data on how mutations can lead to increased genetic variation in a population. HS+B.L3U1.12

### Evolution

27. Obtain, evaluate, and communicate evidence that describes how changes in frequency of inherited traits in a population can lead to biological diversity. HS.L4U1.27
28. Gather, evaluate, and communicate multiple lines of empirical evidence to explain the mechanisms of biological evolution. HS.L4U1.28
13. Obtain, evaluate, and communicate multiple lines of empirical evidence to explain the change in genetic composition of a population over successive generations. HS+B.L4U1.13
14. Construct an explanation based on scientific evidence that the process of natural selection can lead to adaption. HS+B.L4U1.14