Washington Science

9th-12th Grades: Physical Science

Matter and its Interactions HS-PS1

How can one explain the structure, properties, and interactions of matter?

1 Develop and use models of atomic structures and patterns in data to understand the chemical properties of matter including outcomes of chemical reactions, nuclear reactions, and structures of substances. Apply this understanding to the energy of reactions, including rates and equilibrium with a refined design to increase the products of a reaction. WA.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. 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. HS-PS1-2

3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. 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. HS-PS1-4

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 the reaction occurs. [ESE] HS-PS1-5

6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. [Engineering] HS-PS1-6

7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS-PS1-7

8 Develop model 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. HS-PS1-8

Motion and Stability: Fo

How can one explain and predict interactions between objects and within systems of objects?

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2 Plan an investigation, collect data, and use representations to create claims about relationships between net force, mass, and acceleration of a single object and about gravitational and electrostatic forces between objects, including magnets. Apply this understanding to systems of objects, designed materials, and collisions. WA.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. HS-PS2-1

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. HS-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. [Engineering] HS-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 objects. HS-PS2-4

5 Plan and conduct 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. HS-PS2-5

6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Engineering] HS-PS2-6

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Energy HS-PS3

How is energy transferred and conserved?

3 Use models and investigations to represent and understand the energy within objects and energy changes in systems. Apply this understanding through engineering a device that converts energy between forms and by relating how fields can change the energy of an object. WA.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. 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 motions of particles (objects) and energy associated with the relative positions of particles (objects). 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. [Engineering] [ESE] HS-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). 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. HS-PS3-5

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Waves and Their Applications in Technologies for Information Transfer HS-PS4

How are waves used to transfer energy and send and store information?

4 Evaluate the validity and reliability of claims behind the idea that electromagnetic radiation can be described by a wave model and a particle model, the effects different frequencies of electromagnetic radiation have when absorbed by matter, and how the interactions of electromagnetic radiation with matter can be used by technological devices to capture, store, and transmit information and energy. WA.HS.PS4

1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-1

2 Evaluate questions about the advantages of using digital transmission and storage of information. 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. HS-PS4-3

4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromatic radiation have when absorbed by matter. [Climate] 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. [Engineering] HS-PS4-5