

Science Standard Articulated by Grade Level
Strand 5: Physical Science

Concept 1: Properties of Objects and Materials				
Classify objects and materials by their observable properties.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Identify the following observable properties of objects using the senses: <ul style="list-style-type: none"> • shape • texture • size • color (See M00-S4C1-02 and M00-S4C1-03)	PO 1. Classify objects by the following observable properties: <ul style="list-style-type: none"> • shape • texture • size • color • weight 	PO 1. Describe objects in terms of measurable properties (e.g., length, volume, weight, temperature) using scientific tools. (See M02-S4C4-01 and M02-S4C4-02)		
PO 2. Compare objects by the following observable properties: <ul style="list-style-type: none"> • size • color • type of material (See M00-S4C1-02)	PO 2. Classify materials as solids or liquids.	PO 2. Classify materials as solids, liquids, or gases.		
		PO 3. Demonstrate that water can exist as a: <ul style="list-style-type: none"> • gas – vapor • liquid – water • solid – ice 		
		PO 4. Demonstrate that solids have a definite shape and that liquids and gases take the shape of their containers.		

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Science Standard Articulated by Grade Level
Strand 5: Physical Science

Concept 1: Properties and Changes of Properties in Matter			
Understand physical and chemical properties of matter.			
Grade 5	Grade 6	Grade 7	Grade 8
PO 1. Identify that matter is made of smaller units called: <ul style="list-style-type: none"> • molecules (e.g., H₂O, CO₂) • atoms (e.g., H, N, Na) 			PO 1. Identify different kinds of matter based on the following physical properties: <ul style="list-style-type: none"> • states • density • boiling point • melting point • solubility
PO 2. Distinguish between mixtures and compounds.			PO 2. Identify different kinds of matter based on the following chemical properties: <ul style="list-style-type: none"> • reactivity • pH • oxidation (corrosion)
PO 3. Describe changes of matter: <ul style="list-style-type: none"> • physical – cutting wood, ripping paper, freezing water • chemical – burning of wood, rusting of iron, milk turning sour 			PO 3. Identify the following types of evidence that a chemical reaction has occurred: <ul style="list-style-type: none"> • formation of a precipitate • generation of gas • color change • absorption or release of heat
			PO 4. Classify matter in terms of elements, compounds, or mixtures.
			PO 5. Classify mixtures as being homogeneous or heterogeneous.
			PO 6. Explain the systematic organization of the periodic table.

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Science Standard Articulated by Grade Level
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Concept 1: Properties and Changes of Properties in Matter			
Understand physical and chemical properties of matter.			
Grade 5	Grade 6	Grade 7	Grade 8
			PO 7. Investigate how the transfer of energy can affect the physical and chemical properties of matter.

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Concept 1: Structure and Properties of Matter

Understand physical, chemical, and atomic properties of matter.

High School

PO 1. Describe substances based on their physical properties.

PO 2. Describe substances based on their chemical properties.

PO 3. Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).

PO 4. Separate mixtures of substances based on their physical properties.

PO 5. Describe the properties of electric charge and the conservation of electric charge.

PO 6. Describe the following features and components of the atom:

- protons
- neutrons
- electrons
- mass
- number and type of particles
- structure
- organization

PO 7. Describe the historical development of models of the atom.

PO 8. Explain the details of atomic structure (e.g., electron configuration, energy levels, isotopes).

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Concept 2: Position and Motion of Objects				
Understand spatial relationships and the way objects move.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Describe spatial relationships (i.e., above, below, next to, left, right, middle, center) of objects. (See M00-S4C1-02 and 3SS-R1-01)	PO 1. Demonstrate the various ways that objects can move (e.g., straight line, zigzag, back-and-forth, round-and-round, fast, slow).			

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Concept 2: Motion and Forces			
Understand the relationship between force and motion.			
Grade 5	Grade 6	Grade 7	Grade 8
PO 1. Describe the following forces: <ul style="list-style-type: none"> • gravity • friction 			PO 1. Demonstrate velocity as the rate of change of position over time.
PO 2. Describe the various effects forces can have on an object (e.g., cause motion, halt motion, change direction of motion, cause deformation).			PO 2. Identify the conditions under which an object will continue in its state of motion (Newton's 1 st Law of Motion).
PO 3. Examine forces and motion through investigations using simple machines (e.g., wedge, plane, wheel and axle, pulley, lever).			PO 3. Describe how the acceleration of a body is dependent on its mass and the net applied force (Newton's 2 nd Law of Motion).
PO 4. Demonstrate effects of variables on an object's motion (e.g., incline angle, friction, applied forces).			PO 4. Describe forces as interactions between bodies (Newton's 3 rd Law of Motion).
			PO 5. Create a graph devised from measurements of moving objects and their interactions, including: <ul style="list-style-type: none"> • position-time graphs • velocity-time graphs

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Concept 2: Motions and Forces

Analyze relationships between forces and motion.

High School

PO 1. Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).

PO 2. Analyze the relationships among position, velocity, acceleration, and time:

- graphically
- mathematically

PO 3. Explain how Newton's 1st Law applies to objects at rest or moving at constant velocity.

PO 4. Using Newton's 2nd Law of Motion, analyze the relationships among the net force acting on a body, the mass of the body, and the resulting acceleration:

- graphically
- mathematically

PO 5. Use Newton's 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).

PO 6. Analyze the two-dimensional motion of objects by using vectors and their components.

PO 7. Give an example that shows the independence of the horizontal and vertical components of projectile motion.

PO 8. Analyze the general relationships among force, acceleration, and motion for an object undergoing uniform circular motion.

PO 9. Represent the force conditions required to maintain static equilibrium.

PO 10. Describe the nature and magnitude of frictional forces.

PO 11. Using the Law of Universal Gravitation, predict how the gravitational force will change when the distance between two masses changes or the mass of one of them changes.

PO 12. Using Coulomb's Law, predict how the electrical force will change when the distance between two point charges changes or the charge of one of them changes.

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Concept 2: Motions and Forces

Analyze relationships between forces and motion.

High School

PO 13. Analyze the impulse required to produce a change in momentum.

PO 14. Quantify interactions between objects to show that the total momentum is conserved in both collision and recoil situations.

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Science Standard Articulated by Grade Level
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Concept 3: Energy and Magnetism				
Investigate different forms of energy.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Investigate how applied forces (push and pull) can make things move.			PO 1. Demonstrate that light can be: <ul style="list-style-type: none"> • reflected (with mirrors) • refracted (with prisms) • absorbed (by dark surfaces) 	PO 1. Demonstrate that electricity flowing in circuits can produce light, heat, sound, and magnetic effects.
PO 2. Investigate how forces can make things move without another thing touching them (e.g., magnets, static electricity).			PO 2. Describe how light behaves on striking objects that are: <ul style="list-style-type: none"> • transparent (clear plastic) • translucent (waxed paper) • opaque (cardboard) 	PO 2. Construct series and parallel electric circuits.
PO 3. Sort materials according to whether they are or are not attracted by a magnet.			PO 3. Demonstrate that vibrating objects produce sound.	PO 3. Explain the purpose of conductors and insulators in various practical applications.
PO 4. Identify familiar everyday uses of magnets (e.g., in toys, cabinet locks, decoration).			PO 4. Demonstrate that the pitch of a sound depends on the rate of the vibration (e.g., a long rubber band has a lower pitch than a short rubber band).	PO 4. Investigate the characteristics of magnets (e.g., opposite poles attract, like poles repel, the force between two magnet poles depends on the distance between them).
				PO 5. State cause and effect relationships between magnets and circuitry.

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Concept 3: Transfer of Energy			
Understand that energy can be stored and transferred.			
Grade 5	Grade 6	Grade 7	Grade 8
	PO 1. Identify various ways in which electrical energy is generated using renewable and nonrenewable resources (e.g., wind, dams, fossil fuels, nuclear reactions).		
	PO 2. Identify several ways in which energy may be stored.		
	PO 3. Compare the following ways in which energy may be transformed: <ul style="list-style-type: none"> • mechanical to electrical • electrical to thermal 		
	PO 4. Explain how thermal energy (heat energy) can be transferred by: <ul style="list-style-type: none"> • conduction • convection • radiation 		

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Concept 3: Conservation of Energy and Increase in Disorder

Understand ways that energy is conserved, stored, and transferred.

High School

PO 1. Describe the following ways in which energy is stored in a system:

- mechanical
- electrical
- chemical
- nuclear

PO 2. Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation.)

PO 3. Recognize that energy is conserved in a closed system.

PO 4. Calculate quantitative relationships associated with the conservation of energy.

PO 5. Analyze the relationship between energy transfer and disorder in the universe (2nd Law of Thermodynamics).

PO 6. Distinguish between heat and temperature.

PO 7. Explain how molecular motion is related to temperature and phase changes.

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Concept 4: Chemical Reactions

Investigate relationships between reactants and products in chemical reactions.

High School

PO 1. Apply the law of conservation of matter to changes in a system.

PO 2. Identify the indicators of chemical change, including formation of a precipitate, evolution of a gas, color change, absorption or release of heat energy.

PO 3. Represent a chemical reaction by using a balanced equation.

PO 4. Distinguish among the types of bonds (i.e., ionic, covalent, metallic, hydrogen bonding).

PO 5. Describe the mole concept and its relationship to Avogadro's number.

PO 6. Solve problems involving such quantities as moles, mass, molecules, volume of a gas, and molarity using the mole concept and Avogadro's number.

PO 7. Predict the properties (e.g., melting point, boiling point, conductivity) of substances based upon bond type.

PO 8. Quantify the relationships between reactants and products in chemical reactions (e.g., stoichiometry, equilibrium, energy transfers).

PO 9. Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion).

PO 10. Explain the energy transfers within chemical reactions using the law of conservation of energy.

PO 11. Predict the effect of various factors (e.g., temperature, concentration, pressure, catalyst) on the equilibrium state and on the rates of chemical reaction.

PO 12. Compare the nature, behavior, concentration, and strengths of acids and bases.

PO 13. Determine the transfer of electrons in oxidation/reduction reactions.

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Concept 5: Interactions of Energy and Matter

Understand the interactions of energy and matter.

High School

PO 1. Describe various ways in which matter and energy interact (e.g., photosynthesis, phase change).

PO 2. Describe the following characteristics of waves:

- wavelength
- frequency
- period
- amplitude

PO 3. Quantify the relationships among the frequency, wavelength, and the speed of light.

PO 4. Describe the basic assumptions of kinetic molecular theory.

PO 5. Apply kinetic molecular theory to the behavior of matter (e.g., gas laws).

PO 6. Analyze calorimetric measurements in simple systems and the energy involved in changes of state.

PO 7. Explain the relationship between the wavelength of light absorbed or released by an atom or molecule and the transfer of a discrete amount of energy.

PO 8. Describe the relationship among electric potential, current, and resistance in an ohmic system.

PO 9. Quantify the relationships among electric potential, current, and resistance in an ohmic system.

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