ADW Grades 6-8 PHYSICAL SCIENCE STANDARDS & INSTRUCTION GUIDE

PS.1 Matter and Its Interactions	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.1-1	Analyze and interpret data to describe and classify matter as pure substances or mixtures based on composition.	• All matter is made up of atoms. • The atoms of any element are like other atoms of the same element, but are different from the atoms of other elements. • Atoms form chemical bonds to make molecules and compounds that range in size from two to thousands of atoms. • Elements and compounds are pure substances, with physical properties that can be used to identify them (eg. melting and boiling points, density, solubility, reactivity, etc.) • Metric units and tools are used to measure physical characteristics of matter such as mass, volume, and density. • Most matter does not exist in pure form, but is found in combinations called mixtures. • Mixtures can be classified as heterogeneous or homogeneous and components can be separated by physical means.	• matter • substance • mass • density • solubility • atoms • molecules • compounds • subscripts • elements • mixtures (heterogeneous/ homogeneous) • solute • solvent • solutions • concentration	• https://makingscience.withgoogle.com/?lang=en • http://www.chem4kids.com/

PS.1 Matter and Its Interactions	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.1-2	Develop and use simple atomic models to illustrate the relative position and charge of protons, neutrons, and electrons in elements.	• Elements are made up of only one type of atom. • Atoms contain subatomic particles including protons, neutrons, and electrons. • The current atomic model is the result of a progression of scientific experiments over time (atomic theory). • The attraction between positive protons and negative electrons hold an atom together. • The chemical elements combine to form all of the matter in the universe.	• atom • element • subatomic particle • proton • neutron • electron • electron cloud • atomic theory • **Democritus** • **John Dalton** • **J.J. Thomson** • **Ernest Rutherford** • **Niels Bohr** • **Schroedinger**	• http://www.phet.colorado.edu/

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SC.6-8.PS.1-3	Obtain and use information about elements (including chemical symbol, atomic number, atomic mass, and group or family) to describe the organization of the Periodic Table.	• Elements on the modern periodic table are arranged based on atomic number and on similar properties. • Changing the atomic number, changes the element. • Elements are categorized into three main groups: metals, nonmetals, and metalloids. • Properties of elements (e.g. atomic radius, valence numbers, reactivity, etc.) vary in predictable patterns on the periodic table. • Elements tend to form	• atomic number • atomic mass • chemical (atomic) symbol • chemical name • metal • nonmetal • metalloid • electron shells (orbitals)/energy levels) • valence electrons • groups (families) • periods • isotopes • ions • **Dmitri Mendeleev**	• https://www.ptable.com/ • http://daqri-elementsweb.s3.amazonaws.com/lesson_plans/E4D_LessonPlan_MS.pdf

PS.1 Matter and Its Interactions	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.1-4	Develop models that predict and describe changes in particle motion, density, temperature, and state of a pure substance when thermal energy is added or removed or when changes in pressure occur.	• Gases and liquids are made of molecules or atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others. • In a gas, the molecules are widely spaced, except when they happen to collide. • In a solid, atoms are closely spaced and may vibrate in position without changing relative positions. • Solids may be formed from molecules or they may be extended structures with repeating subunits (crystals). • Thermal energy always moves from hot to cold until equilibrium has been reached. • The addition of heat (thermal energy) to a substance increases the speed of the atoms, which eventually alters the substance's state of matter. • Removing heat (thermal energy) from a substance decreases the speed of the atoms, which eventually alters the substances state of matter.	• solid • liquid • viscosity • surface tension • gas • crystals • properties • thermal energy • temperature • evaporation • boiling • condensation • sublimation • freezing • melting • deposition • melting point • boiling point • pressure • **Gas Laws (Boyle, Charles, Gay-Lussac, Combined)**	• https://ngss.nsta.org/Resource.aspx?ResourceID=454

PS.1 Matter and Its Interactions	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.1-5	Analyze the properties of substances before and after substances interact to determine if a chemical reaction has occurred.	• Substances have distinct physical properties (color, conductivity, phase, etc.) and chemical properties (reactivity, flammability, etc.) • Unlike physical changes, chemical changes result in the formation of new substances-the atoms are regrouped into different molecules-and these new substances have different properties from those of the reactants. • Substances react chemically in characteristic ways. • When substances interact to form new substances, the atoms that make up the original substance(s) combine in new ways. • Ionic compounds form when metals react chemically with nonmetals. • Physical changes (e.g. changes in color, phase changes, etc.) often occur during chemical reactions.	• physical changes • chemical changes • physical properties • chemical properties • chemical reaction	• https://phet.colorado.edu/en/simulation/reactions-and-rates

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SC.6-8.PS.1-6	Balance chemical equations to show how the total number of atoms for each element does not change in chemical reactions and as a result, mass is always conserved in a closed system.	• The total number of each type of atom is conserved during a chemical change and the mass does not change. • This is described by The Law of Conservation of Mass, which states that matter is neither created nor destroyed during a chemical reaction. • Chemical equations are written to represent the reactants and products of a chemical reaction. • Coefficients are used to balance chemical equations. • Scientists use balanced equations in order to calculate the amount of reactants consumed or products formed in a chemical reaction. • Some chemical reactions release energy, others store energy.	• Law of conservation of Mass • coefficient • subscript • reactants • products • chemical equation • atoms • elements • endothermic • exothermic • The Law of Conservation of Energy • activation energy • enzyme • inhibitor • catalyst • **Lavoisier** • **Einstein**	• https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=408

PS.2 Motion and Forces	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
MS.PS.2-1	Plan and conduct controlled investigations to explore Newton's first law of motion (Law of Inertia) and how different forces (gravity, friction, push and pull) affect the velocity of an object.	• Motion occurs when there is a change in position of an object with respect to a reference point. • Inertia is the tendency of objects to resist any change in motion. • Newton's first law of motion states that an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force. • Newton's first law of motion can be used to describe real world situations such as the pulling of a tablecloth from under plates, the importance of wearing a seatbelt, the motion of objects in space, etc.	• inertia • force • balanced forces • unbalanced forces • motion • gravity • friction • vectors • net force • speed • velocity • weight • mass • distance • displacement • Isaac Newton	• http://education.abc.net.au/res/i/L1198/index.html

PS.2 Motion and Forces	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.2-2	Analyze and interpret data to show the relationship between force and mass and action and reaction forces.	• Newton's second law of motion (Law of Acceleration) states that the acceleration produced by a net force on an object is directly proportional to the net force, is in the same direction as the net force, and is inversely proportional to the mass of the object. • Acceleration can be calculated by dividing net force by the mass of the object. • Newton's third law of motion (Law of action-reaction) states that whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first. • Forces occur in pairs, with one representing an action and one representing a reaction. Neither force exists without the other. • Newton's third law of motion can be applied to real world situations such as rockets interacting with air molecules, etc.	• acceleration • a=F/m • action • reaction	• http://content3.jason.org/resource_content/content/digitallab/4859/misc_content/public/coaster.html

PS.2 Motion and Forces	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.PS.2-3E	Construct a device that uses one or more of Newton's laws of motion and use mathematics and computational thinking to explain how motion, acceleration, force, and mass are affecting the device.	• Balloon cars, canister rockets, mousetrap cars, catapults, etc. can be designed to investigate Newton's laws of motion. • *Prototypes are developed in order to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved. • *Competing design solutions can be evaluated using a systematic process to identify how well they meet the criteria and constraints of the problem.	• acceleration • motion • force • mass • momentum	• http://education.abc.net.au/res/i/L1198/index.html
SC.6-8.PS.2-4	Describe the motion of an object graphically showing the relationship between time and position.	• Displacement and velocity include the direction the object has moved relative to the origin (distance). • Motion can be measured and represented on a graph. • On a graph of position vs. time, the velocity of an object is reflected in the slope of the graph. • When an object is at rest the slope on a position vs. time graph is equal to 0.	• position • reference point • distance • displacement • speed=d/time • velocity • relative motion time • speed • slope	• https://www.physicsclassroom.com/Physics-Interactives/1-D-Kinematics/Graph-That-Motion/Graph-That-Motion-Interactive
SC.6-8.PS.2-5	Create models to demonstrate the factors that affect the strength of electric and magnetic forces.	• Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	• electricity • magnetic forces • electromagnetism • force fields • electrical circuit • parallel circuit	• https://study.com/academy/topic/electricity-and-magnetic-force.html

		• Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object or a ball, respectively). • Energy can be transferred by electric currents. • Electrical circuit components can be arranged in series and/or parallel circuits.	• series circuit • current • voltage • resistance	

PS.3 Energy and Waves	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.MS.PS.3-1	Investigate a process in which energy is changed from one form to another; provide evidence that the total amount of energy does not change.	• Energy is the capacity to do work. • Kinetic energy is the energy of motion (e.g. thermal, motion, sound, electrical, and light) • Objects may also contain stored (potential) energy (e.g. chemical, nuclear, gravitational, or mechanical) • Energy can be changed from potential to kinetic forms and vice versa or from one type of kinetic or potential energy to another. • Real world examples of how energy is transformed in a system include car engines, light bulbs, a toaster, roller coasters etc. • The Law of Conservation of Energy states that energy is not created or destroyed in a system. • In a closed system, matter and energy do not leave the system and remain constant.	• energy • potential energy • kinetic energy • energy transformation • Law of Conservation of Energy • open system • closed system • power • work	• Www.explorelearning.com

PS.3 Energy and Waves	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
		• In an open system, matter and energy can enter or leave the system. • Almost all systems are open, allowing for the transfer of energy to the surroundings.		
SC.6-8.PS.3-2	Investigate the properties of light, sound, and other energy waves and how they are reflected, absorbed, and transmitted through materials and space.	• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. • Unlike light waves, sound waves require a medium through which they are transmitted. • When light shines on an object it is reflected, absorbed, or transmitted through the object depending on the object's material and the frequency (color) of the light. • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g. air and water, air and glass) where the light path bends.	• reflection • refraction • absorption • wavelength • frequency • amplitude • visible light • electromagnetic radiation • crest • trough	• https://www.scholastic.com/teachers/activities/teaching-content/energy-light-and-sound-10-studyjams-interactive-science-activities/

		• There are a great variety of electromagnetic waves varying in wavelength from radio waves to gamma rays. • Mathematical representations can be used to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.		
SC.6-8.PS.3-3E	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	• In science, the term heat describes the movement of thermal energy from one object to another. • Thermal energy is the total energy of a system, while temperature measures the average kinetic energy. • The transfer of thermal energy occurs due to the temperature difference between two objects- heat flows from warmer matter to cooler matter. • Heat can be transferred through materials by the collision of atoms (conduction), or across space by radiation. • Fluids aid the transfer of heat through convection currents. • Convection currents appear spontaneously when density differences caused by heating are acted on by a gravitational field (e.g. in water, the atmosphere, or Earth's mantle or outer core) • Heat transfer can be decreased by the use of insulating materials (e.g. nonmetals).	• heat • temperature • thermal energy • conduction • radiation • convection current • fluid • conductor • insulator	• https://betterlesson.com/lesson/634878/heat-transfer-lab-rotation-conduction-convection-and-radiation?from=cc_lesson

		• *Prototypes are developed in order to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved. • *Competing design solutions can be evaluated using a systematic process to identify how well they meet the criteria and constraints of the problem		