Alignment Document
State of New York and Aventa Learning Physical Science

Physical Science

2005-2007 Benchmark Blueprint

Discipline	Standards	Key Ideas	Benchmarks	Unit Name	Course Topic Description
P Physics	**P.1** Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.	**P.1.1** Abstraction and symbolic representation are used to communicate mathematically.	**P.1.M1.1** Use algebraic and geometric representations to describe and compare data.		
			P.1.M1.1.a use scaled diagrams to represent and manipulate vector quantities		
			P.1.M1.1.b represent physical quantities in graphical form solutions	Matter	Mass and Density Assignment
			P.1.M1.1.c construct graphs of real-world data (scatter plots, line or curve of best fit)	Matter Matter Simple Machines	Graphical Analysis of Data Mass and Density Assignment Bike Lab
			P.1.M1.1.d manipulate equations to solve for unknowns	Motion Motion Forces Energy Energy Simple Machines	Calculating Speed Acceleration Newton's Second Law of Motion Potential Energy Work Mechanical Advantage

				Simple Machines Simple Machines Waves Electricity & Magnetism Matter Matter	Calculating Power Calculating Efficiency Waves Ohm's Law Density Factor Label Method
			P.1.M1.1.e use dimensional analysis to confirm algebraic	Matter	Dimensional Analysis and Unit Conversion
		P.1.2 Deductive and inductive reasoning are used to reach mathematical conclusions.	**P.1.M2.1** Use deductive reasoning to construct and evaluate conjectures and arguments, recognizing that patterns and relationships in mathematics assist them in arriving at these conjectures and arguments.	Simple Machines Matter Matter	Bike Lab Phase Changes Mass and Density Assignment
			P.1.M2.1.a interpret graphs to determine the mathematical relationship between the variables	Simple Machines Matter Matter	Bike Lab Phase Changes Mass and Density Assignment
		P.1.3 Critical thinking skills are used in the solution of mathematical problems.	**P.1.M3.1** Apply algebraic and geometric concepts and skills to the solution of problems.	Matter	Mass and Density Assignment
			P.1.M3.1.a explain the physical relevance of properties of a graphical representation of real-world data, e.g., slope, intercepts, area under the curve	Simple Machines Matter Matter	Bike Lab Graphical Analysis of Data Mass and Density Assignment
		P.1.1 The central purpose of scientific inquiry is to develop	**P.1.1.1** develop extended visual models and mathematical formulations to represent an understanding of natural		

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		explanations of natural phenomena in a continuing, creative process.	phenomena		
			P.1.1.2 clarify ideas through reasoning, research, and discussion		
			P.1.1.3 evaluate competing explanations and overcome misconceptions		
		P.1.2 Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.	**P.1.S2.1** Devise ways of making observations to test proposed explanations.	Forces	Acceleration of Gravity Lab
			P.1.S2.1.a design an experiment to investigate the relationship between physical phenomena	Forces	Acceleration of Gravity Lab
			P.1.S2.2 Refine research ideas through library investigations, including electronic information retrieval and reviews of the literature, and through peer feedback obtained from review and discussion.		
			P.1.S2.3 Develop and present proposals including formal hypotheses to test explanations; i.e., predict what should be observed under specific conditions if the explanation is true.	Forces	Acceleration of Gravity Lab
			P.1.S2.4 Carry out a research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary. (Note: This could apply to many activities from simple investigations to long-term projects.)		
		P.1.3 The observations made while testing proposed explanations, when analyzed using	**P.1.S3.1** Use various means of representing and organizing observations (e.g., diagrams, tables, charts, graphs, and equations) and insightfully interpret the organized data.	Doing Science Doing Science Motion	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab

		conventional and invented methods, provide new insights into phenomena.		Simple Machines	Bike Lab
			P.1.S3.1.a use appropriate methods to present scientific information (e.g., lab reports, posters, research papers, or multimedia presentations)	Doing Science Doing Science Motion Forces Simple Machines	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab Acceleration of Gravity Lab Bike Lab
			P.1.S3.1.b identify possible sources of error in data collection and explain their effects on experimental results	Doing Science Doing Science Motion	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab
			P.1.S3.2 Apply statistical analysis techniques when appropriate to test if chance alone explains the result.		
			P.1.S3.2.a examine collected data to evaluate the reliability of experimental results, including percent error, range, standard deviation, line of best fit, and the use of the correct number of significant digits		
			P.1.S3.3 Assess correspondence between the predicted result contained in the hypothesis and the actual result, and reach a conclusion as to whether or not the explanation on which the prediction was based is supported.	Doing Science Doing Science Motion Simple Machines	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab Bike Lab
			P.1.S3.4 Based on the results of the test		

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			and through public discussion, revise the explanation and contemplate additional research. (Note: Public discussion may include lab partners, lab groups, classes, etc.)		
		P.1.1 Engineering design is an iterative process involving modeling and optimization (finding the best solution within given constraints) which is used to develop technological solutions to problems within given constraints. (Note: The design process could apply to activities from simple investigations to long-term projects.)	**P.1.T1.1** Students engage in the following steps of a design process:		
			P.1.T1.1.a initiate and carry out a thorough investigation of an unfamiliar situation and identify needs and opportunities for technological invention or innovation		
			P.1.T1.1.b identify, locate, and use a wide range of information resources, and document through notes and sketches how findings relate to the problem		
			P.1.T1.1.c generate creative solutions, break ideas into significant functional elements, and explore possible refinements; predict possible outcomes, using mathematical and functional modeling techniques; choose the optimal solution to the problem, clearly documenting ideas against design criteria and constraints; and explain how human understandings, economics, ergonomics, and environmental considerations have influenced the solution		
			P.1.T1.1.d develop work schedules and working plans which include optimal use and cost of materials, processes, time, and expertise; construct a model of the solution, incorporating developmental modifications while working to a high		

			degree of quality (craftsmanship)		
			P.1.T1.1.e devise a test of the solution according to the design criteria and perform the test; record, portray, and logically evaluate performance test results through quantitative, graphic, and verbal means. Use a variety of creative verbal and graphic techniques effectively and persuasively to present conclusions, predict impacts and new problems, and suggest and pursue modifications		
	P.2 Students will access, generate, process, and transfer information, using appropriate technologies.	**P.2.1** Information technology is used to retrieve, process, and communicate information as a tool to enhance learning.	**P.2.1.1** Understand and use the more advanced features of word processing, spreadsheets, and database software.		
			P.2.1.2 Prepare multimedia presentations demonstrating a clear sense of audience and purpose. (Note: Multimedia may include posters, slides, images, presentation software, etc.)		
			P.2.1.2.a extend knowledge of physical phenomena through independent investigation, e.g., literature review, electronic resources, library research		
			P.2.1.2.b use appropriate technology to gather experimental data, develop models, and present results		
			P.2.1.3 Access, select, collate, and analyze information obtained from a wide range of sources such as research databases, foundations, organizations, national libraries, and electronic communication networks, including the Internet.		
			P.2.1.3.a use knowledge of physics to evaluate articles in the popular press on		

			contemporary scientific topics		
			P.2.1.4 Utilize electronic networks to share information.	Doing Science Motion Motion Forces Energy Energy Energy Simple Machines Waves Matter Atomic Structure Chemical Bonds Chemical Reactions	Observational Study versus Experiment Discussion Motion Discussion Newton and Seat Belts Discussion Momentum Discussion Energy Use Discussion Specific Heat Discussion Losing Heat Discussion Levers Discussion Sound Barrier Discussion SI Units Discussion Nuclear Medicine Discussion Trans Fats Discussion Synthetic Fertilizer Discussion
			P.2.1.5 Model solutions to a range of problems in mathematics, science, and technology, using computer simulation software.		
			P.2.1.5.a use software to model and extend classroom and laboratory experiences, recognizing the differences		

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			between the model used for understanding and real-world behavior		
		P.2.2 Knowledge of the impacts and limitations of information systems is essential to its effective and ethical use.			
		P.2.3 Information technology can have positive and negative impacts on society, depending upon how it is used.			
	P.4 Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.	**P.4.4** Energy exists in many forms, and when these forms change energy is conserved.	**P.4.4.1** Students can observe and describe transmission of various forms of energy.	Energy Energy Energy Waves Waves Waves Electricity & Magnetism Electricity & Magnetism	Potential Energy Kinetic Energy Work Waves Sound Waves Electromagnetic Radiation Static Electricity Electrical Current
			P.4.4.1.a All energy transfers are governed by the law of conservation of energy.	Energy Chemical Reactions	Conservation of Energy Energy and Chemical Reactions

			P.4.4.1.b Energy may be converted among mechanical, electromagnetic, nuclear, and thermal forms.	Energy Energy Energy Energy Energy Waves Waves Waves Electricity & Magnetism Chemical Reactions	Potential Energy Kinetic Energy Work Conservation of Energy Heat and Temperature Waves Sound Waves Electromagnetic Radiation Electrical Current Energy and Chemical Reactions
			P.4.4.1.c Potential energy is the energy an object possesses by virtue of its position or condition. Types of potential energy include gravitational and elastic.	Energy	Potential Energy
			P.4.4.1.d Kinetic energy is the energy an object possesses by virtue of its motion.	Energy	Kinetic Energy
			P.4.4.1.e In an ideal mechanical system, the sum of the macroscopic kinetic and potential energies (mechanical energy) is constant.	Energy	Conservation of Energy
			P.4.4.1.f In a nonideal mechanical system, as mechanical energy decreases there is a corresponding increase in other energies such as		

			internal energy.		
			P.4.4.1.g When work is done on or by a system, there is a change in the total energy of the system.		
			P.4.4.1.h Work done against friction results in an increase in the internal energy of the system.		
			P.4.4.1.i Power is the time-rate at which work is done or energy is expended.	Simple Machines	Calculating Power
			P.4.4.1.j Energy may be stored in electric or magnetic fields. This energy may be transferred through conductors or space and may be converted to other forms of energy.	Electricity & Magnetism	Conductors and Insulators
			P.4.4.1.k Moving electric charges produce magnetic fields. The relative motion between a conductor and a magnetic field may produce a potential difference in the conductor.	Electricity & Magnetism	Magnetism
			P.4.4.1.l All materials display a range of conductivity. At constant temperature, common metallic conductors obey Ohm's Law.	Electricity & Magnetism Electricity & Magnetism	Electrical Current Ohm’s Law
			P.4.4.1.m The factors affecting resistance in a conductor are length, cross-sectional area, temperature, and resistivity.		
			P.4.4.1.n A circuit is a closed path in which a current can exist. (Note: Use conventional current.)	Electricity & Magnetism	Electrical Current
			P.4.4.1.o Circuit components may be connected in series or in parallel. Schematic dia-grams are used to represent circuits and circuit elements.	Electricity & Magnetism	Electrical Current
			P.4.4.1.p Electrical power and energy	Electricity &	Electrical Current

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			can be determined for electric circuits.	Magnetism	
			P.4.4.3 Students can explain variations in wavelength and frequency in terms of the source of the vibrations that produce them, e.g., molecules, electrons, and nuclear particles.	Waves	Electromagnetic Radiation
			P.4.4.3.a An oscillating system produces waves. The nature of the system determines the type of wave produced.	Waves	Waves
			P.4.4.3.b Waves carry energy and information without transferring mass. This energy may be carried by pulses or periodic waves.	Waves	
			P.4.4.3.c The model of a wave incorporates the characteristics of amplitude, wavelength, frequency, period, wave speed, and phase.	Waves Atomic Structure	Waves Electromagnetic Radiation and Light
			P.4.4.3.d Mechanical waves require a material medium through which to travel.	Waves Waves	Waves Sound Waves
			P.4.4.3.e Waves are categorized by the direction in which particles in a medium vibrate about an equilibrium position relative to the direction of propagation of the wave, such as transverse and longitudinal waves.	Waves	Waves
			P.4.4.3.f Resonance occurs when energy is transferred to a system at its natural frequency.		
			P.4.4.3.g Electromagnetic radiation exhibits wave characteristics. Electromagnetic waves can propagate through a vacuum.	Waves Atomic Structure and the Periodic Table	Electromagnetic Radiation Electromagnetic Radiation and Light
			P.4.4.3.h When a wave strikes a boundary between two media, reflection,	Waves	Wave Properties of Light

			transmission, and absorption occur. A transmitted wave may be refracted.		
			P.4.4.3.i When a wave moves from one medium into another, the wave may refract due to a change in speed. The angle of refraction (measured with respect to the normal) depends on the angle of incidence and the properties of the media (indices of refraction).	Waves	Wave Properties of Light
			P.4.4.3.j The absolute index of refraction is inversely proportional to the speed of a wave.	Waves	Wave Properties of Light
			P.4.4.3.k All frequencies of electromagnetic radiation travel at the same speed in a vacuum.	Waves Atomic Structure	Electromagnetic Radiation Electromagnetic Radiation and Light
			P.4.4.3.l Diffraction occurs when waves pass by obstacles or through openings. The wave-length of the incident wave and the size of the obstacle or opening affect how the wave spreads out.	Waves	Diffraction
			P.4.4.3.m When waves of a similar nature meet, the resulting interference may be explained using the principle of superposition. Standing waves are a special case of interference.	Waves	Diffraction Lab
			P.4.4.3.n When a wave source and an observer are in relative motion, the observed frequency of the waves traveling between them is shifted (Doppler effect).		
		P.4.5 Energy and matter interact through forces that result in changes in motion.	**P.4.5.1** Students can explain and predict different patterns of motion of objects (e.g., linear and uniform circular motion, velocity and acceleration, momentum and inertia).	Motion Motion Motion	Motion Calculating Speed Acceleration

				Motion Forces Forces Forces Forces	Newton's First Law of Motion Newton's Second Law of Motion Projectile Motion Newton's Third Law Momentum
			P.4.5.1.a Measured quantities can be classified as either vector or scalar.	Motion	Calculating Speed
			P.4.5.1.b A vector may be resolved into perpendicular components.	Motion	Calculating Speed
			P.4.5.1.c The resultant of two or more vectors, acting at any angle, is determined by vector addition.	Motion	Calculating Speed
			P.4.5.1.d An object in linear motion may travel with a constant velocity or with acceleration. (Note: Testing of acceleration will be limited to cases in which acceleration is constant.)	Motion Motion	Motion Acceleration
			P.4.5.1.e An object in free fall accelerates due to the force of gravity. Friction and other forces cause the actual motion of a falling object to deviate from its theoretical motion. (Note: Initial velocities of objects in free fall may be in any direction.)	Forces	Free Fall
			P.4.5.1.f The path of a projectile is the result of the simultaneous effect of the horizontal and vertical components of its motion; these components act independently.	Forces	Projectile Motion
			P.4.5.1.g A projectile's time of flight is dependent upon the vertical component	Forces	Projectile Motion

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			of its motion.		
			P.4.5.1.h The horizontal displacement of a projectile is dependent upon the horizontal component of its motion and its time of flight.	Forces	Projectile Motion
			P.4.5.1.i According to Newton's First Law, the inertia of an object is directly proportional to its mass. An object remains at rest or moves with constant velocity, unless acted upon by an unbalanced force.	Motion	Newton’s First Law of Motion
			P.4.5.1.j When the net force on a system is zero, the system is in equilibrium.		
			P.4.5.1.k According to Newton's Second Law, an unbalanced force causes a mass to accelerate.	Motion	Newton’s Second Law of Motion
			P.4.5.1.l Weight is the gravitational force with which a planet attracts a mass. The mass of an object is independent of the gravitational field in which it is located.	Motion Motion	Newton’s Second Law of Motion Gravity
			P.4.5.1.m The elongation or compression of a spring depends upon the nature of the spring (its spring constant) and the magnitude of the applied force.		
			P.4.5.1.n Centripetal force is the net force which produces centripetal acceleration. In uniform circular motion, the centripetal force is perpendicular to the tangential velocity.		
			P.4.5.1.o Kinetic friction is a force that opposes motion.		
			P.4.5.1.p The impulse imparted to an object causes a change in its momentum.		

			P.4.5.1.q According to Newton's Third Law, forces occur in action/ reaction pairs. When one object exerts a force on a second, the second exerts a force on the first that is equal in magnitude and opposite in direction.	Forces	Newton's Third Law
			P.4.5.1.r Momentum is conserved in a closed system. (Note: Testing will be limited to momentum in one dimension.)		
			P.4.5.1.s Field strength and direction are determined using a suitable test particle. (Notes: 1) Calculations are limited to electrostatic and gravitational fields. 2) The gravitational field near the surface of Earth and the electrical field between two oppositely charged parallel plates are treated as uniform.)		
			P.4.5.1.t Gravitational forces are only attractive, whereas electrical and magnetic forces can be attractive or repulsive.	Forces Electricity & Magnetism	Gravity Magnetism
			P.4.5.1.u The inverse square law applies to electrical and gravitational fields produced by point sources.		
			P.4.5.3 Students can compare energy relationships within an atom's nucleus to those outside the nucleus. Major Understandings:		
			P.4.5.3.a States of matter and energy are restricted to discrete values (quantized).	Atomic Structure and the Periodic Table	Light as a Particle
			P.4.5.3.b Charge is quantized on two levels. On the atomic level, charge is restricted to multiples of the elementary charge (charge on the electron or proton). On the subnuclear level, charge	Atomic Structure and the Periodic Table Atomic Structure	Discoveries Leading to the Modern Atomic Theory Atomic Model

			appears as fractional values of the elementary charge (quarks).	and the Periodic Table	
			P.4.5.3.c On the atomic level, energy is emitted or absorbed in discrete packets called photons.	Atomic Structure and the Periodic Table	Light as a Particle
			P.4.5.3.d The energy of a photon is proportional to its frequency.	Atomic Structure and the Periodic Table	Light as a Particle
			P.4.5.3.e On the atomic level, energy and matter exhibit the characteristics of both waves and particles.	Atomic Structure and the Periodic Table	Light as a Particle
			P.4.5.3.f Among other things, mass-energy and charge are conserved at all levels (from sub-nuclear to cosmic).		
			P.4.5.3.g The Standard Model of Particle Physics has evolved from previous attempts to explain the nature of the atom and states that:		
			P.4.5.3.g.1 atomic particles are composed of subnuclear particles		
			P.4.5.3.g.2 the nucleus is a conglomeration of quarks which manifest themselves as protons and neutrons		
			P.4.5.3.g.3 each elementary particle has a corresponding antiparticle		
			P.4.5.3.h Behaviors and characteristics of matter, from the microscopic to the cosmic levels, are manifestations of its atomic structure. The macroscopic characteristics of matter, such as electrical and optical properties, are the result of microscopic interactions.		
			P.4.5.3.i The total of the fundamental interactions is responsible for the appearance and behavior of the objects		

			in the universe.		
			P.4.5.3.j The fundamental source of all energy in the universe is the conversion of mass into energy.		
	P.6 Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.	**P.6.1** Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.	**P.6.1.1** Define boundary conditions when doing systems analysis to determine what influences a system and how it behaves.		
		P.6.2 Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.	**P.6.2.1** Revise a model to create a more complete or improved representation of the system.	Electricity & Magnetism	All Charged Up Lab
			P.6.2.2 Collect information about the behavior of a system and use modeling tools to represent the operation of the system.		
			P.6.2.2.a use observations of the behavior of a system to develop a model		
			P.6.2.3 Find and use mathematical models that behave in the same manner as the processes under investigation.		
			P.6.2.3.a represent the behavior of real-world systems, using physical and mathematical models		
			P.6.2.4 Compare predictions to actual observations, using test models.		
			P.6.2.4.a validate or reject a model based on collated experimental data		
			P.6.2.4.b predict the behavior of a system, using a model		

		P.6.3 The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems.	**P.6.3.1** Describe the effects of changes in scale on the functioning of physical, biological, or designed systems.		
			P.6.3.2 Extend their use of powers of ten notation to understanding the exponential function and performing operations with exponential factors.		
			P.6.3.2.a estimate quantitative results, using orders of magnitude		
			P.6.3.2.b simplify calculations by using scientific notation		
		P.6.4 Equilibrium is a state of stability due either to a lack of change (static equilibrium) or a balance between opposing forces (dynamic equilibrium).	**P.6.4.1** Describe specific instances of how disturbances might affect a system's equilibrium, from small disturbances that do not upset the equilibrium to larger disturbances (threshold level) that cause the system to become unstable.	Chemical Reactions	Equilibria
			P.6.4.2 Cite specific examples of how dynamic equilibrium is achieved by equality of change in opposing directions.	Chemical Reactions	Equilibria
		P.6.5 Identifying patterns of change is necessary for making predictions about future behavior and conditions.	**P.6.5.1** Use sophisticated mathematical models, such as graphs and equations of various algebraic or trigonometric functions.	Simple Machines Matter Matter	Bike Lab Phase Changes Mass and Density Assignment
			P.6.5.1.a predict the behavior of physical systems, using mathematical models such as graphs and equations	Simple Machines Matter	Bike Lab Phase Changes

				Matter	Mass and Density Assignment
			P.6.5.2 Search for multiple trends when analyzing data for patterns, and identify data that do not fit the trends.		
			P.6.5.2.a deduce patterns from the organization and presentation of data		
			P.6.5.2.b identify and develop models, using patterns in data		
		P.6.6 In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs.	**P.6.6.1** determine optimal solutions to problems that can be solved using quantitative methods		
	P.7 Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.	**P.7.1** The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/ technology/society, consumer decision making, design, and inquiry into phenomena.	**P.7.1.1** address real-world problems, using scientific methodology	Doing Science Doing Science Motion Forces Simple Machines	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab Acceleration of Gravity Lab Bike Lab
		P.7.2 Solving interdisciplinary problems involves a variety of skills and strategies, including	**P.7.2.1** collect, analyze, interpret, and present data, using appropriate tools	Doing Science Doing Science	Introductory Physical Science Lab Bouncing Ball Lab

		effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.		Motion Forces Simple Machines	Inertia Lab Acceleration of Gravity Lab Bike Lab
			P.7.2.2 If students participate in an extended, culminating mathematics, science, and technology project, then students should:		
			P.7.2.2.a work effectively		
			P.7.2.2.b gather and process information		
			P.7.2.2.c generate and analyze ideas		
			P.7.2.2.d observe common themes		
			P.7.2.2.e realize ideas		
			P.7.2.2.f present results		
C Chemistry	**C.1** Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.	**C.1.1** Abstraction and symbolic representation are used to communicate mathematically.	**C.1.M1.1** Use algebraic and geometric representations to describe and compare data.	Simple Machines	Bike Lab
			C.1.M1.1.a organize, graph, and analyze data gathered from laboratory activities or other sources	Doing Science Doing Science Motion Forces Simple Machines	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab Acceleration of Gravity Lab Bike Lab
			C.1.M1.1.a.1 identify independent and dependent variables		
			C.1.M1.1.a.2 create appropriate axes with labels and scale	Matter Matter	Graphical Analysis of Data Mass and Density Assignment
			C.1.M1.1.a.3 identify graph points	Matter	Graphical Analysis of Data

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			clearly	Matter	Mass and Density Assignment
			C.1.M1.1.b measure and record experimental data and use data in calculations	Doing Science Doing Science Motion Forces Simple Machines	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab Acceleration of Gravity Lab Bike Lab
			C.1.M1.1.b.1 choose appropriate measurement scales and use units in recording	Matter	Measurements in chemistry
			C.1.M1.1.b.2 show mathematical work, stating formula and steps for solution	Matter	Solving Quantitative Problems
			C.1.M1.1.b.3 estimate answers	Matter	Solving Quantitative Problems
			C.1.M1.1.b.4 use appropriate equations and significant digits	Matter	Working with Numbers from Measurements in Calculations
			C.1.M1.1.b.5 show uncertainty in measurement by the use of significant figures	Matter	Significant Figures
			C.1.M1.1.b.7 calculate percent error	Matter	Uncertainty in Measurement
			C.1.M1.1.c recognize and convert various scales of measurement	Matter	Measurements in Chemistry
			C.1.M1.1.c.1 temperature - Celsius (°C), Kelvin (K)	Matter	Fundamental SI Units
			C.1.M1.1.c.2 length - kilometers (km), meters (m), centimeters (cm), millimeters (mm)	Matter	Fundamental SI Units
			C.1.M1.1.c.3 mass - grams (g), kilograms (kg)	Matter	Fundamental SI Units
			C.1.M1.1.c.4 pressure - kilopascal (kPa), atmosphere (atm)	Matter	Fundamental SI Units

			C.1.M1.1.d use knowledge of geometric arrangements to predict particle properties or behavior	Chemical Bonding	Molecular Shape
		C.1.2 Deductive and inductive reasoning are used to reach mathematical conclusions.	**C.1.M2.1** Use deductive reasoning to construct and evaluate conjectures and arguments, recognizing that patterns and relationships in mathematics assist them in arriving at these conjectures and arguments.		
			C.1.M2.1.a interpret a graph constructed from experimentally obtained data	Simple Machines	Bike Lab
			C.1.M2.1.a.1 identify relationships - direct, inverse	Matter	Graphical Analysis of Data
			C.1.M2.1.a.2 apply data showing trends to predict information	Atomic Structure and the Periodic Table	Structure of the Periodic Table
		C.1.3 Critical thinking skills are used in the solution of mathematical problems.	**C.1.M3.1** Apply algebraic and geometric concepts and skills to the solution of problems.	Motion Motion Forces Energy Energy Simple Machines Simple Machines Simple Machines Waves Electricity & Magnetism	Calculating Speed Acceleration Newton's Second Law of Motion Potential Energy Work Mechanical Advantage Calculating Power Calculating Efficiency Waves Ohm's Law

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				Matter Matter	Density Factor Label Method
			C.1.M3.1.a state assumptions which apply to the use of a particular mathematical equation and evaluate these assumptions to see if they have been met		
			C.1.M3.1.b evaluate the appropriateness of an answer, based on given data	Matter	Solving Quantitative Problems
		C.1.1 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.	**C.1.S1.1** Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent thinking.		
			C.1.S1.1.a use theories and/ or models to represent and explain observations		
			C.1.S1.1.b use theories and/ or principles to make predictions about natural phenomena		
			C.1.S1.1.c develop models to explain observations		
			C.1.S1.2 Hone ideas through reasoning, library research, and discussion with others, including experts.		
			C.1.S1.2.a locate data from published sources to support/ defend/ explain patterns observed in natural phenomena		
			C.1.S1.3 Work towards reconciling competing explanations, clarifying points of agreement and disagreement.		
			C.1.S1.3.a evaluate the merits of various scientific theories and indicate why one theory was accepted over		

			another		
		C.1.2 Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proofed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.	**C.1.S2.1** Devise ways of making observations to test proposed explanations.	Forces	Acceleration of Gravity Lab
			C.1.S2.1.a design and/ or carry out experiments, using scientific methodology to test proposed calculations	Forces	Acceleration of Gravity Lab
			C.1.S2.2 Refine research ideas through library investigations, including information retrieval and reviews of the literature, and through peer feedback obtained from review and discussion.		
			C.1.S2.2.a use library investigations, retrieved information, and literature reviews to improve the experimental design of an experiment		
			C.1.S2.3 Develop and present proposals including formal hypotheses to test explanations, i.e.; they predict what should be observed under specific conditions if their explanation is true.	Doing Science Motion Forces	Introductory Lab Inertia Lab Acceleration of Gravity Lab
			C.1.S2.3.a develop research proposals in the form of "if X is true and a particular test Y is done, then prediction Z will occur"		
			C.1.S2.4 Carry out a research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary.	Forces	Acceleration of Gravity Lab
			C.1.S2.4.a determine safety procedures to accompany a research plan		
		C.1.3 The observations made while testing	**C.1.S3.1** Use various means of representing and organizing observations (e.g., diagrams, tables,	Doing Science	Introductory Physical Science Lab

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		proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.	charts, graphs, equations, and matrices) and insightfully interpret the organized data.	Doing Science Motion Forces Simple Machines	Bouncing Ball Lab Inertia Lab Acceleration of Gravity Lab Bike Lab
			C.1.S3.1.a organize observations in a data table, analyze the data for trends or patterns, and interpret the trends or patterns, using scientific concepts	Doing Science Doing Science Motion	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab
			C.1.S3.2 Apply statistical analysis techniques when appropriate to test if chance alone explains the result.	-	
			C.1.S3.3 Assess correspondence between the predicted result contained in the hypothesis and the actual result, and reach a conclusion as to whether or not the explanation on which the prediction is supported.	Doing Science Doing Science Motion	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab
			C.1.S3.3.a evaluate experimental methodology for inherent sources of error and analyze the possible effect on the result	Doing Science Doing Science Motion	Introductory Physical Science Lab Bouncing Ball Lab Inertia Lab
			C.1.S3.3.b compare the experimental result to the expected result; calculate the percent error as appropriate		
			C.1.S3.4 Using results of the test and through public discussion, revise the explanation and contemplate additional research.		
			C.1.S3.5 Develop a written report for		

			public scrutiny that describes the proposed explanation, including a literature review, the research carried out, its results, and suggestions for further research.		
		C.1.1 Engineering design is an iterative process involving modeling and optimization (finding the best solution within given constraints); this process is used to develop technological solutions to problems within given constraints.	**C.1.1.1** If students are asked to do a design project, then:		
			C.1.T1.1.a Initiate and carry out a thorough investigation of an unfamiliar situation and identify needs and opportunities for technological invention or innovation.		
			C.1.T1.1.b Identify, locate, and use a wide range of information resources, and document through notes and sketches how findings relate to the problem.		
			C.1.T1.1.c Generate creative solutions, break ideas into significant functional elements, and explore possible refinements; predict possible outcomes, using mathematical and functional modeling techniques; choose the optimal solution to the problem, clearly documenting ideas against design criteria and constraints; and explain how human understandings, economics, ergonomics, and environmental considerations have influenced the solution.		
			C.1.T1.1.d Develop work schedules and working plans which include optimal use and cost of materials, processes, time, and expertise; construct a model of the solution, incorporating developmental modifications while working to a high		

			degree of quality (craftsmanship).		
			C.1.T1.1.e Devise a test of the solution according to the design criteria and perform the test; record, portray, and logically evaluate performance test results through quantitative, graphic, and verbal means. Use a variety of creative verbal and graphic techniques effectively and persuasively to present conclusions, predict impact and new problems, and suggest and pursue modifications.		
	C.2 Students will access, generate, process, and transfer information using appropriate technologies.	**C.2.1** Information technology is used to retrieve, process, and communicate information as a tool to enhance learning. Examples include:	**C.2.1.1** use the Internet as a source to retrieve information for classroom use, e.g., Periodic Table, acid rain		
		C.2.2 Knowledge of the impacts and limitations of information systems is essential to its effectiveness and ethical use. Examples include:	**C.2.2.1** critically assess the value of information with or without benefit of scientific backing and supporting data, and evaluate the effect such information could have on public judgment or opinion, e.g., environmental issues		
			C.2.2.2 discuss the use of the peer-review process in the scientific community and explain its value in maintaining the integrity of scientific publication, e.g., "cold fusion"		
	C.4 Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in	**C.4.3** Matter is made up of particles whose properties determine the observable characteristics of	**C.4.3.1** Explain the properties of materials in terms of the arrangement and properties of the atoms that compose them.	Atomic Structure and the Periodic Table	Periodic Trends
			C.4.3.1.a The modern model of the atom has evolved over a long period of time	Atomic Structure and the Periodic	The Discovery of the Atom

	science.	matter and its reactivity.	through the work of many scientists.	Table Atomic Structure and the Periodic Table	 Atomic Model
			C.4.3.1.b Each atom has a nucleus, with an overall positive charge, surrounded by negatively charged electrons.	Atomic Structure and the Periodic Table Atomic Structure and the Periodic Table	The Discovery of the Atom Atomic Model
			C.4.3.1.c Subatomic particles contained in the nucleus include protons and neutrons.	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.d The proton is positively charged, and the neutron has no charge. The electron is negatively charged.	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.e Protons and electrons have equal but opposite charges. The number of protons equals the number of electrons in an atom.	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.f The mass of each proton and each neutron is approximately equal to one atomic mass unit. An electron is much less massive than a proton or a neutron.	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.g The number of protons in an atom (atomic number) identifies the element. The sum of the protons and neutrons in an atom (mass number) identifies an isotope. Common notations that represent isotopes include: 14 C, 14 C, carbon-14, C-14. 6	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.h In the wave-mechanical model	Atomic Structure	Electronic Structure

			(electron cloud model) the electrons are in orbitals, which are defined as the regions of the most probable electron location (ground state).	and the Periodic Table	
			C.4.3.1.i Each electron in an atom has its own distinct amount of energy.	Atomic Structure and the Periodic Table	Electronic Structure
			C.4.3.1.j When an electron in an atom gains a specific amount of energy, the electron is at a higher energy state (excited state).	Atomic Structure and the Periodic Table	Electronic Structure
			C.4.3.1.k When an electron returns from a higher energy state to a lower energy state, a specific amount of energy is emitted. This emitted energy can be used to identify an element.	Atomic Structure and the Periodic Table	Electronic Structure
			C.4.3.1.l The outermost electrons in an atom are called the valence electrons. In general, the number of valence electrons affects the chemical properties of an element.	Atomic Structure and the Periodic Table	The Quantum Model of the Atom
			C.4.3.1.m Atoms of an element that contain the same number of protons but a different number of neutrons are called isotopes of that element.	Atomic Structure and the Periodic Table	Atomic Model
			C.4.3.1.n The average atomic mass of an element is the weighted average of the masses of its naturally occurring isotopes.	Atomic Structure and the Periodic Table	Determining the Mass of an Atom
			C.4.3.1.o Stability of an isotope is based on the ratio of neutrons and protons in its nucleus. Although most nuclei are stable, some are unstable and spontaneously decay, emitting radiation.		
			C.4.3.1.p Spontaneous decay can involve the release of alpha particles,		

			beta particles, positrons, and/ or gamma radiation from the nucleus of an unstable isotope. These emissions differ in mass, charge, ionizing power, and penetrating power.		
			C.4.3.1.q Matter is classified as a pure substance or as a mixture of substances.	Matter	Classification of Matter
			C.4.3.1.r A pure substance (element or compound) has a constant composition and constant properties throughout a given sample, and from sample to sample.	Matter	Classification of Matter
			C.4.3.1.s Mixtures are composed of two or more different substances that can be separated by physical means. When different substances are mixed together, a homogeneous or heterogeneous mixture is formed.	Matter	Classification of Matter
			C.4.3.1.t The proportions of components in a mixture can be varied. Each component in a mixture retains its original properties.	Matter	Classification of Matter
			C.4.3.1.u Elements are substances that are composed of atoms that have the same atomic number. Elements cannot be broken down by chemical change.	Matter	Classification of Matter
			C.4.3.1.v Elements can be classified by their properties and located on the Periodic Table as metals, nonmetals, metalloids (B, Si, Ge, As, Sb, Te), and noble gases.	Matter Matter Atomic Structure and the Periodic Table	Pure Substances The Periodic Table Periodic Trends
			C.4.3.1.w Elements can be differentiated by physical properties.	Matter	Properties of Matter

			Physical properties of substances, such as density, conductivity, malleability, solubility, and hardness, differ among elements.		
			C.4.3.1.x Elements can also be differentiated by chemical properties. Chemical properties describe how an element behaves during a chemical reaction.	Matter	Properties of Matter
			C.4.3.1.y The placement or location of an element on the Periodic Table gives an indication of the physical and chemical properties of that element. The elements on the Periodic Table are arranged in order of increasing atomic number.	Matter Atomic Structure and the Periodic Table Atomic Structure and the Periodic Table	The Periodic Table Structure of the Periodic Table Periodic Trends
			C.4.3.1.z For Groups 1, 2, and 13-18 on the Periodic Table, elements within the same group have the same number of valence electrons (helium is an exception) and therefore similar chemical properties.	Atomic Structure and the Periodic Table	Groups in the Periodic Table
			C.4.3.1.aa The succession of elements within the same group demonstrates characteristic trends: differences in atomic radius, ionic radius, electronegativity, first ionization energy, metallic/ nonmetallic properties.	Atomic Structure and the Periodic Table	Groups in the Periodic Table
			C.4.3.1.ab The succession of elements across the same period demonstrates characteristic trends: differences in atomic radius, ionic radius, electronegativity, first ionization energy, metallic/ nonmetallic properties.	Atomic Structure and the Periodic Table	Periodic Trends

			C.4.3.1.ac A compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. A chemical compound can be broken down by chemical means. A chemical compound can be represented by a specific chemical formula and assigned a name based on the IUPAC system.	Matter	Classification of Matter
			C.4.3.1.ad Compounds can be differentiated by their physical and chemical properties.	Matter	Classification of Matter
			C.4.3.1.ae Types of chemical formulas include empirical, molecular, and structural.	Chemical Bonding Chemical Bonding	Chemical Formulas and Compounds Using Chemical Formulas
			C.4.3.1.af Organic compounds contain carbon atoms, which bond to one another in chains, rings, and networks to form a variety of structures. Organic compounds can be named using the IUPAC system.		
			C.4.3.1.ag Hydrocarbons are compounds that contain only carbon and hydrogen. Saturated hydrocarbons contain only single carbon-carbon bonds. Unsaturated hydrocarbons contain at least one multiple carbon-carbon bond.		
			C.4.3.1.ah Organic acids, alcohols, esters, aldehydes, ketones, ethers, halides, amines, amides, and amino acids are categories of organic compounds that differ in their structures. Functional groups impart distinctive		

			physical and chemical properties to organic compounds.		
			C.4.3.1.ai Isomers of organic compounds have the same molecular formula, but different structures and properties.		
			C.4.3.1.aj The structure and arrangement of particles and their interactions determine the physical state of a substance at a given temperature and pressure.	Chemical Bonding	Molecular Shape
			C.4.3.1.ak The three phases of matter (solids, liquids, and gases) have different properties.	Matter	States of Matter
			C.4.3.1.al Entropy is a measure of the randomness or disorder of a system. A system with greater disorder has greater entropy.		
			C.4.3.1.am Systems in nature tend to undergo changes toward lower energy and higher entropy.		
			C.4.3.1.an Differences in properties such as density, particle size, molecular polarity, boiling and freezing points, and solubility permit physical separation of the components of the mixture.	Matter	Physical and Chemical Changes
			C.4.3.1.ao A solution is a homogeneous mixture of a solute dissolved in a solvent. The solubility of a solute in a given amount of solvent is dependent on the temperature, the pressure, and the chemical natures of the solute and solvent.	Matter	Mixtures
			C.4.3.1.ap The concentration of a solution may be expressed in molarity (M), percent by volume, percent by		

			mass, or parts per million (ppm).		
			C.4.3.1.aq The addition of a nonvolatile solute to a solvent causes the boiling point of the solvent to increase and the freezing point of the solvent to decrease. The greater the concentration of solute particles, the greater the effect.		
			C.4.3.1.ar An electrolyte is a substance which, when dissolved in water, forms a solution capable of conducting an electric current. The ability of a solution to conduct an electric current depends on the concentration of ions.		
			C.4.3.1.as The acidity or alkalinity of an aqueous solution can be measured by its pH value. The relative level of acidity or alkalinity of these solutions can be shown by using indicators.		
			C.4.3.1.at On the pH scale, each decrease of one unit of pH represents a tenfold increase in hydronium ion concentration.		
			C.4.3.1.au Behavior of many acids and bases can be explained by the Arrhenius theory. Arrhenius acids and bases are electrolytes.		
			C.4.3.1.av Arrhenius acids yield H + (aq), hydrogen ion as the only positive ion in an aqueous solution. The hydrogen ion may also be written as H 3 O + (aq), hydronium ion.		
			C.4.3.1.aw Arrhenius bases yield OH - (aq), hydroxide ion as the only negative ion in an aqueous solution.		
			C.4.3.1.ax In the process of neutralization, an Arrhenius acid and an		

			Arrhenius base react to form a salt and water.		
			C.4.3.1.ay There are alternate acid-base theories. One theory states that an acid is an H + donor and a base is an H + acceptor.		
			C.4.3.1.az Titration is a laboratory process in which a volume of a solution of known concentration is used to determine the concentration of another solution.		
			C.4.3.2 Use atomic and molecular models to explain common chemical reactions.	Chemical Reactions	Types of Reactions
			C.4.3.2.a A physical change results in the rearrangement of existing particles in a substance. A chemical change results in the formation of different substances with changed properties.	Matter	Physical and Chemical Changes
			C.4.3.2.b Types of chemical reactions include synthesis, decomposition, single replacement, and double replacement.	Chemical Reactions	Types of Reactions
			C.4.3.2.c Types of organic reactions include addition, substitution, polymerization, esterification, fermentation, saponification, and combustion.		
			C.4.3.2.d An oxidation-reduction (redox) reaction involves the transfer of electrons (e -).		
			C.4.3.2.e Reduction is the gain of electrons.		
			C.4.3.2.f A half-reaction can be written to represent reduction.		
			C.4.3.2.g Oxidation is the loss of electrons.		

			C.4.3.2.h A half-reaction can be written to represent oxidation.		
			C.4.3.2.i Oxidation numbers (states) can be assigned to atoms and ions. Changes in oxidation numbers indicate that oxidation and reduction have occurred.		
			C.4.3.2.j An electrochemical cell can be either voltaic or electrolytic. In an electrochemical cell, oxidation occurs at the anode and reduction at the cathode.		
			C.4.3.2.k A voltaic cell spontaneously converts chemical energy to electrical energy.		
			C.4.3.2.l An electrolytic cell requires electrical energy to produce a chemical change. This process is known as electrolysis.		
			C.4.3.3 Apply the principle of conservation of mass to chemical reactions.	Chemical Reactions	Chemical Equations and Reactions
			C.4.3.3.a In all chemical reactions there is a conservation of mass, energy, and charge.	Chemical Reactions	Chemical Equations and Reactions
			C.4.3.3.b In a redox reaction the number of electrons lost is equal to the number of electrons gained.		
			C.4.3.3.c A balanced chemical equation represents conservation of atoms. The coefficients in a balanced chemical equation can be used to determine mole ratios in the reaction.	Chemical Reactions Chemical Reactions	Chemical Equations and Reactions Balancing Reactions
			C.4.3.3.d The empirical formula of a compound is the simplest whole-number ratio of atoms of the elements in a compound. It may be different from the	Chemical Bonding	Using Chemical Formulas

			molecular formula, which is the actual ratio of atoms in a molecule of that compound.		
			C.4.3.3.e The formula mass of a substance is the sum of the atomic masses of its atoms. The molar mass (gram-formula mass) of a substance equals one mole of that substance.	Chemical Bonding	Using Chemical Formulas
			C.4.3.3.f The percent composition by mass of each element in a compound can be calculated mathematically.		
			C.4.3.4 Use kinetic molecular theory (KMT) to explain rates of reactions and the relationships among temperature, pressure, and volume of a substance.	Chemical Reactions	Reaction Rate
			C.4.3.4.a The concept of an ideal gas is a model to explain the behavior of gases. A real gas is most like an ideal gas when the real gas is at low pressure and high temperature.		
			C.4.3.4.b Kinetic molecular theory (KMT) for an ideal gas states that all gas particles:		
			C.4.3.4.b.1 are in random, constant, straight-line motion.	Matter	States of Matter
			C.4.3.4.b.2 are separated by great distances relative to their size; the volume of the gas particles is considered negligible.	Matter	States of Matter
			C.4.3.4.b.3 have no attractive forces between them.		
			C.4.3.4.b.4 have collisions that may result in a transfer of energy between gas particles, but the total energy of the system remains constant.		
			C.4.3.4.c Kinetic molecular theory		

			describes the relationships of pressure, volume, temperature, velocity, and frequency and force of collisions among gas molecules.		
			C.4.3.4.d Collision theory states that a reaction is most likely to occur if reactant particles collide with the proper energy and orientation.		
			C.4.3.4.e Equal volumes of gases at the same temperature and pressure contain an equal number of particles.		
			C.4.3.4.f The rate of a chemical reaction depends on several factors: temperature, concentration, nature of the reactants, surface area, and the presence of a catalyst.	Chemical Reactions	Reaction Rate
			C.4.3.4.g A catalyst provides an alternate reaction pathway, which has a lower activation energy than an uncatalyzed reaction.	Chemical Reactions	Reaction Rate
			C.4.3.4.h Some chemical and physical changes can reach equilibrium.	Chemical Reactions	Equilibria
			C.4.3.4.i At equilibrium the rate of the forward reaction equals the rate of the reverse reaction. The measurable quantities of reactants and products remain constant at equilibrium.	Chemical Reactions	Equilibria
			C.4.3.4.j LeChatelier's principle can be used to predict the effect of stress (change in pressure, volume, concentration, and temperature) on a system at equilibrium.	Chemical Reactions	Equilibria
		C.4.4 Energy exists in many forms, and when these forms change energy is	**C.4.4.1** Observe and describe transmission of various forms of energy.	Energy	Conservation of Energy
			C.4.4.1.a Energy can exist in different forms, such as chemical, electrical,	Energy	Conservation of Energy

		conserved.	electromagnetic, thermal, mechanical, nuclear.		
			C.4.4.1.b Chemical and physical changes can be exothermic or endothermic.	Chemical Reactions	Energy and Chemical Reactions
			C.4.4.1.c Energy released or absorbed during a chemical reaction can be represented by a potential energy diagram.	Chemical Reactions	Energy and Chemical Reactions
			C.4.4.1.d Energy released or absorbed during a chemical reaction (heat of reaction) is equal to the difference between the potential energy of the products and potential energy of the reactants.	Chemical Reactions	Energy and Chemical Reactions
			C.4.4.2 Explain heat in terms of kinetic molecular theory.	Energy	Heat and Temperature
			C.4.4.2.a Heat is a transfer of energy (usually thermal energy) from a body of higher temperature to a body of lower temperature. Thermal energy is the energy associated with the random motion of atoms and molecules.	Energy	Heat and Temperature
			C.4.4.2.b Temperature is a measurement of the average kinetic energy of the particles in a sample of material. Temperature is not a form of energy.	Energy	Heat and Temperature
			C.4.4.2.c The concepts of kinetic and potential energy can be used to explain physical processes that include: fusion (melting), solidification (freezing), vaporization (boiling, evaporation), condensation, sublimation, and deposition.		
			C.4.4.4 Explain the benefits and risks of		

			radioactivity.		
			C.4.4.4.a Each radioactive isotope has a specific mode and rate of decay (half-life).		
			C.4.4.4.b Nuclear reactions include natural and artificial transmutation, fission, and fusion.		
			C.4.4.4.c Nuclear reactions can be represented by equations that include symbols which represent atomic nuclei (with mass number and atomic number), subatomic particles (with mass number and charge), and/or emissions such as gamma radiation.		
			C.4.4.4.d Radioactive isotopes have many beneficial uses. Radioactive isotopes are used in medicine and industrial chemistry for radioactive dating, tracing chemical and biological processes, industrial measurement, nuclear power, and detection and treatment of diseases.		
			C.4.4.4.e There are inherent risks associated with radioactivity and the use of radioactive isotopes. Risks can include biological exposure, long-term storage and disposal, and nuclear accidents.		
			C.4.4.4.f There are benefits and risks associated with fission and fusion reactions.		
		C.4.5 Energy and matter interact through forces that result in changes in motion.	**C.4.5.2** Explain chemical bonding in terms of the behavior of electrons.	Chemical Bonds Chemical Bonds Chemical Bonds	Bonding Ionic Bonds Covalent Bonds

				Chemical Bonds	Metallic Bonding
			C.4.5.2.a Chemical bonds are formed when valence electrons are:	Chemical Bonds	Bonding
			C.4.5.2.a.1 transferred from one atom to another (ionic)	Chemical Bonds	Ionic Bonds
			C.4.5.2.a.2 shared between atoms (covalent)	Chemical Bonds	Covalent Bonds
			C.4.5.2.a.3 mobile within a metal (metallic)	Chemical Bonds	Metallic Bonding
			C.4.5.2.b Atoms attain a stable valence electron configuration by bonding with other atoms. Noble gases have stable valence configurations and tend not to bond.	Chemical Bonds	Covalent Bonding
			C.4.5.2.c When an atom gains one or more electrons, it becomes a negative ion and its radius increases. When an atom loses one or more electrons, it becomes a positive ion and its radius decreases.	Chemical Bonds	Ionic Bonding
			C.4.5.2.d Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions.	Chemical Bonds	Electron Dot Symbols
			C.4.5.2.e In a multiple covalent bond, more than one pair of electrons are shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond.	Chemical Bonds	Covalent Bonds
			C.4.5.2.f Some elements exist in two or more forms in the same phase. These forms differ in their molecular or crystal structure, and hence in their properties.		
			C.4.5.2.g Two major categories of compounds are ionic and molecular	Chemical Bonds	Bonding

			(covalent) compounds.	Chemical Bonds Chemical Bonds	Ionic Bonds Covalent Bonds
			C.4.5.2.h Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds containing polyatomic ions have both ionic and covalent bonding.	Chemical Bonds Chemical Bonds Chemical Bonds	Bonding Ionic Bonds Covalent Bonds
			C.4.5.2.i When a bond is broken, energy is absorbed. When a bond is formed, energy is released.	Chemical Bonds	Covalent Bonds
			C.4.5.2.j Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. Electronegativity values are assigned according to arbitrary scales.	Atomic Structure and the Periodic Table	Periodic Trends
			C.4.5.2.k The electronegativity difference between two bonded atoms is used to assess the degree of polarity in the bond.	Chemical Bonds Chemical Bonds	Bonding Intermolecular Forces
			C.4.5.2.l Molecular polarity can be determined by the shape of the molecule and distribution of charge. Symmetrical (nonpolar) molecules include CO2 , CH4 , and diatomic elements. Asymmetrical (polar) molecules include HCl, NH3 , and H2 O.	Chemical Bonds Chemical Bonds	Molecular Shape Intermolecular Forces
			C.4.5.2.m Intermolecular forces created by the unequal distribution of charge result in varying degrees of attraction between molecules. Hydrogen bonding is an example of a strong intermolecular force.	Chemical Bonds	Intermolecular Forces
			C.4.5.2.n Physical properties of	Chemical Bonds	Bonding

			substances can be explained in terms of chemical bonds and intermolecular forces. These properties include conductivity, malleability, solubility, hardness, melting point, and boiling point.	Chemical Bonds Chemical Bonds Chemical Bonds Chemical Bonds	Ionic Bonding Covalent Bonding Metallic Bonding Intermolecular Forces
			C.4.5.3 Compare energy relationships within an atom's nucleus to those outside the nucleus.		
			C.4.5.3.a A change in the nucleus of an atom that converts it from one element to another is called transmutation. This can occur naturally or can be induced by the bombardment of the nucleus with high-energy particles.		
			C.4.5.3.b Energy released in a nuclear reaction (fission or fusion) comes from the fractional amount of mass that is converted into energy. Nuclear changes convert matter into energy.		
			C.4.5.3.c Energy released during nuclear reactions is much greater than the energy released during chemical reactions.		
	C.6 Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.	**C.6.1** Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform	**C.6.1.1** use the concept of systems and surroundings to describe heat flow in a chemical or physical change, e.g., dissolving process	Energy	Heat and Temperature

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		specific functions. Examples include:			
		C.6.2 Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.	**C.6.2.1** Revise a model to create a more complete or improved representation of the system.		
			C.6.2.1.a show how models are revised in response to experimental evidence, e.g., atomic theory, Periodic Table		
			C.6.2.2 Collect information about the behavior of a system and use modeling tools to represent the operation of the system.		
			C.6.2.2.a show how information about a system is used to create a model, e.g., kinetic molecular theory (KMT)		
			C.6.2.3 Find and use mathematical models that behave in the same manner as the processes under investigation.		
			C.6.2.3.a show how mathematical models (equations) describe a process, e.g., combine.g.s law		
			C.6.2.4 Compare predictions to actual observations, using test models.		
			C.6.2.4.a compare experimental results to a predicted value, e.g., percent error		
		C.6.3 The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense	**C.6.3.1** Describe the effects of changes in scale on the functioning of physical, biological, or designed information systems.		
			C.6.3.1.a show how microscale processes can resemble or differ from real-world processes, e.g., microscale chemistry		
			C.6.3.2 Extend the use of powers of ten notation to understanding the exponential function and performing		

		range and the changes in scale that affect the behavior and design of systems.	operations with exponential factors.		
			C.6.3.2.a use powers often to represent a large range of values for a physical quantity, e.g., pH scale		
		C.6.4 Equilibrium is a state of stability due either to a lack of change (static equilibrium) or a balance between opposing forces (dynamic equilibrium).	**C.6.4.1** Describe specific instances of how disturbances might affect a system's equilibrium, from small disturbances that do not upset the equilibrium to larger disturbances (threshold level) that cause the system to become unstable.		
			C.6.4.1.a explain how a small change might not affect a system, e.g., activation energy		
			C.6.4.2 Cite specific examples of how dynamic equilibrium is achieved by equality of change in opposing directions.		
			C.6.4.2.a explain how a system returns to equilibrium in response to a stress, e.g., LeChatelier's principle	Chemical Reactions	Equilibria
		C.6.5 Identifying patterns of change is necessary for making predictions about future behavior and conditions. Examples include:	**C.6.5.1** use graphs to make predictions, e.g., half-life, solubility	Matter Simple Machines	Mass and Density Assignment Bike Lab
			C.6.5.2 use graphs to identify patterns and interpret experimental data, e.g., heating and cooling curves	Matter Simple Machines	Mass and Density Assignment Bike Lab
	C.7 Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.	**C.7.1** The knowledge and skills of mathematics, science, and technology are used together to make	**C.7.1.1** Analyze science/ technology/ society problems and issues on a community, national, or global scale and plan and carry out a remedial course of action.		
			C.7.1.1.a carry out a remedial course of		

		informed decisions and solve problems, especially those relating to issues of science/ technology/ society, consumer decision making, design, and inquiry into phenomena.	action by communicating the plan to others, e.g., writing and sending "a letter to the editor"		
			C.7.1.2 Analyze and quantify consumer product data, understand environmental and economic impacts, develop a method for judging the value and efficacy of competing products, and discuss cost-benefit and risk-benefit trade-offs made in arriving at the optimal choice.		
			C.7.1.2.a compare and analyze specific consumer products, e.g., antacids, vitamin C		
			C.7.1.3 Design solutions to real-world problems on a community, national, or global scale, using a technological design process that integrates scientific investigation and rigorous mathematical analysis of the problem and of the solution.		
			C.7.1.3.a design a potential solution to a regional problem, e.g., suggest a plan to adjust the acidity of a lake in the Adirondacks		
			C.7.1.4 Explain and evaluate phenomena mathematically and scientifically by formulating a testable hypothesis, demonstrating the logical connections between the scientific concepts guiding the hypothesis and the design of an experiment, applying and inquiring into the mathematical ideas relating to investigation of phenomena, and using (and if needed, designing) technological tools and procedures to		

			assist in the investigation and in the communication of results.		
			C.7.1.4.a design an experiment that requires the use of a mathematical concept to solve a scientific problem, e.g., an experiment to compare the density of different types of soda pop		
		C.7.2 Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.	**C.7.2.1** If students are asked to do a project, then the project would require students to:		
			C.7.2.1.a work effectively		
			C.7.2.1.b gather and process information		
			C.7.2.1.c generate and analyze ideas		
			C.7.2.1.d observe common themes		
			C.7.2.1.e realize ideas		
			C.7.2.1.f present results		