AVENTA LEARNING

Alignment Document
State of New York and Aventa Learning Physics

Physics
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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab

				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.M1.1.a use scaled diagrams to represent and manipulate vector quantities	Physics and the Laws of Motion	2-Dimensional Motion and Vectors
				Physics and the Laws of Motion	Forces and the Laws of Motion
				Electricity	Electric Forces and Fields
				Magnetism and Atomic Physics	Magnetism
			P.1.M1.1.b represent physical quantities in graphical form solutions	Physics and the Laws of Motion	Free-Fall Acceleration Lab
			P.1.M1.1.c construct graphs of real-world data (scatter plots, line or curve of best fit)	Physics and the Laws of Motion	Free-Fall Acceleration Lab

			P.1.M1.1.d manipulate equations to solve for unknowns	Physics and the Laws of Motion	Motion in One Dimension
				Heat and Thermodynamics	Heat
				Waves	Vibrations and Waves
				Electricity	Electrical Energy and Current
			P.1.M1.1.e use dimensional analysis to confirm algebraic		
		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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab

				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.M2.1.a interpret graphs to determine the mathematical relationship between the variables	Physics and the Laws of Motion	Free-Fall Acceleration Lab
		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.	Physics and the Laws of Motion	2-Dimensional Motion and Vectors
				Physics and the Laws of Motion	Forces and the Laws of Motion
				Electricity	Electric Forces and Fields
				Magnetism and Atomic Physics	Magnetism
			P.1.M3.1.a explain the physical relevance of properties of a graphical representation of real-world data, e.g.,	Physics and the Laws of Motion	Free-Fall Acceleration Lab

			slope, intercepts, area under the curve		
		P.1.1 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.	**P.1.1.1** develop extended visual models and mathematical formulations to represent an understanding of natural phenomena	Waves Waves	Light Converging Lenses Lab
			P.1.1.2 clarify ideas through reasoning, research, and discussion	Waves Waves Electricity	Sound Discussion Light Discussion Hybrid Vehicle 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.	Physics and the Laws of Motion Physics and the Laws of Motion Physics and the Laws of Motion Energy and Motion Energy and Motion Energy and Motion Heat and Thermodynamics Heat and Thermodynamics	Free Fall Acceleration Lab Projectile Motion Lab Forces and Friction Lab Conservation of Mechanical Energy Lab Momentum Lab Machines and Efficiency Lab Thermal Equilibrium Lab Piston Lab

				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.S2.1.a design an experiment to investigate the relationship between physical phenomena	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab

				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect 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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab

				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect 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 conventional and invented methods, provide new insights into phenomena.	**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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab

				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.S3.1.a use appropriate methods to present scientific information (e.g., lab reports, posters, research papers, or multimedia presentations)	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the	Forces and Friction Lab

				Laws of Motion	
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab

				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.S3.1.b identify possible sources of error in data collection and explain their effects on experimental results	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab

				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect 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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab

				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			P.1.S3.4 Based on the results of the test 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	Electricity	Hybrid Vehicle Discussion
			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.	Physics and the Laws of Motion Physics and the Laws of Motion Physics and the Laws of Motion Energy and Motion Energy and Motion Energy and Motion Heat and Thermodynamics Heat and Thermodynamics Waves Waves Waves	Free Fall Acceleration Lab Projectile Motion Lab Forces and Friction Lab Conservation of Mechanical Energy Lab Momentum Lab Machines and Efficiency Lab Thermal Equilibrium Lab Piston Lab Simple Harmonic Motion Lab Wave Lab Sound Lab

				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			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	Magnetism and Atomoic Physics	Magnetism and Atomic Physics Discussion (Paper)
			P.2.1.2.b use appropriate technology to gather experimental data, develop models, and present results	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and	Conservation of Mechanical

				Motion	Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab

			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	Waves Waves Electricity	Sound Discussion Light Pollution Discussion Hybrid Vehicle Discussion
			P.2.1.4 Utilize electronic networks to share information.	Waves Waves Electricity Magnetism and Atomic Physics	Sound Discussion Light Pollution Discussion Hybrid Vehicle Discussion Magnetism and Atomic Physics 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 between the model used for understanding and real-world behavior	Physics and the Laws of Motion Physics and the Laws of Motion Physics and the Laws of Motion Energy and Motion	Free Fall Acceleration Lab Projectile Motion Lab Forces and Friction Lab Conservation of Mechanical Energy Lab

				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
		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 and Motion Heat and Thermodynamics Electricity	Work and Energy Thermodynamics Electrical Energy and Current
			P.4.4.1.a All energy transfers are governed by the law of conservation of energy.	Energy and Motion	Work and Energy
			P.4.4.1.b Energy may be converted among mechanical, electromagnetic, nuclear, and thermal forms.	Energy and Motion Heat and Thermodynamics Electricity Magnetism and Atomic Physics	Work and Energy Thermodynamics Electrical Energy and Current Atomic Physics
			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 and Motion	Work and Energy

			P.4.4.1.d Kinetic energy is the energy an object possesses by virtue of its motion.	Energy and Motion	Work and 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 and Motion Energy and Motion	Work and Energy Momentum and Collisions
			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.	Heat and Thermodynamics	Thermodynamics
			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.	Energy and Motion	Work and Energy
			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.	Energy and Motion	Work and Energy
			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 and Atomic Physics Magnetism and Atomic Physics	Electrical Energy and Current Magnetism Electromagnetic Induction
			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.	Magnetism and Atomic Physics	Electromagnetic Induction
			P.4.4.1.l All materials display a range of conductivity. At constant temperature, common metallic conductors obey	Electricity Electricity	Electrical Energy and Current Current and Resistance Lab

			Ohm's Law.		
			P.4.4.1.m The factors affecting resistance in a conductor are length, cross-sectional area, temperature, and resistivity.	Electricity Electricity	Electrical Energy and Current Current and Resistance Lab
			P.4.4.1.n A circuit is a closed path in which a current can exist. (Note: Use conventional current.)	Electricity	Electrical Energy and 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 Electricity	Circuits and Circuit Elements Resistors in Series and Parallel Lab
			P.4.4.1.p Electrical power and energy can be determined for electric circuits.	Electricity	Electrical Energy and Current
			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.		
			P.4.4.3.a An oscillating system produces waves. The nature of the system determines the type of wave produced.	Waves Waves Waves Waves	Vibrations and Waves Simple Harmonic Motion Lab Sound Lab Wave Lab
			P.4.4.3.b Waves carry energy and information without transferring mass. This energy may be carried by pulses or periodic waves.	Waves	Vibrations and Waves
			P.4.4.3.c The model of a wave incorporates the characteristics of amplitude, wavelength, frequency, period, wave speed, and phase.	Waves	Vibrations and Waves
			P.4.4.3.d Mechanical waves require a material medium through which to travel.	Waves	Vibrations and 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	Vibrations and 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	Light
			P.4.4.3.h When a wave strikes a boundary between two media, reflection, transmission, and absorption occur. A transmitted wave may be refracted.	Waves Waves	Vibrations and Waves Light
			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	Light
			P.4.4.3.j The absolute index of refraction is inversely proportional to the speed of a wave.	Waves	Light
			P.4.4.3.k All frequencies of electromagnetic radiation travel at the same speed in a vacuum.	Waves	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	Light
			P.4.4.3.m When waves of a similar	Waves	Light

			nature meet, the resulting interference may be explained using the principle of superposition. Standing waves are a special case of interference.		
			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).	Waves	Sound
		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).	Physics and the Laws of Motion Energy and Motion Energy and Motion	Forces and the Laws of Motion Circular Motion and Gravitation Momentum and Collisions
			P.4.5.1.a Measured quantities can be classified as either vector or scalar.	Physics and the Laws of Motion	Two Dimensional Motion and Vectors
			P.4.5.1.b A vector may be resolved into perpendicular components.	Physics and the Laws of Motion Physics and the Laws of Motion	Two Dimensional Motion and Vectors Projectile Motion Lab
			P.4.5.1.c The resultant of two or more vectors, acting at any angle, is determined by vector addition.	Physics and the Laws of Motion Physics and the Laws of Motion	Two Dimensional Motion and Vectors Projectile Motion Lab
			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.)	Physics and the Laws of Motion	Motion in One Dimension
			P.4.5.1.e An object in free fall accelerates due to the force of gravity.	Physics and the Laws of Motion	Free-Fall Acceleration Lab

			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.)	Physics and the Laws of Motion	Forces and the Laws of Motion
			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.	Physics and the Laws of Motion Physics and the Laws of Motion	Two Dimensional Motion and Vectors Projectile Motion Lab
			P.4.5.1.g A projectile's time of flight is dependent upon the vertical component of its motion.	Physics and the Laws of Motion Physics and the Laws of Motion	Two Dimensional Motion and Vectors Projectile Motion Lab
			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.	Physics and the Laws of Motion Physics and the Laws of Motion	Two Dimensional Motion and Vectors Projectile Motion Lab
			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.	Physics and the Laws of Motion	Forces and the Laws of Motion
			P.4.5.1.j When the net force on a system is zero, the system is in equilibrium.	Physics and the Laws of Motion Physics and the Laws of Motion	Forces and the Laws of Motion Forces and Friction Lab
			P.4.5.1.k According to Newton's Second Law, an unbalanced force causes a mass to accelerate.	Physics and the Laws of Motion Physics and the Laws of Motion	Forces and the Laws of Motion Forces and Friction Lab

			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.	Energy and Motion	Circular Motion and Gravitation
			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.	Energy and Motion	Conservation of Mechanical Energy Lab
			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.	Energy and Motion	Circular Motion and Gravitation
			P.4.5.1.o Kinetic friction is a force that opposes motion.	Physics and the Laws of Motion Physics and the Laws of Motion	Forces and the Laws of Motion Forces and Friction Lab
			P.4.5.1.p The impulse imparted to an object causes a change in its momentum.	Energy and Motion	Momentum and Collisions
			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.	Physics and the Laws of Motion	Forces and the Laws of Motion
			P.4.5.1.r Momentum is conserved in a closed system. (Note: Testing will be limited to momentum in one dimension.)	Energy and Motion Energy and Motion	Momentum and Collisions Momentum Lab
			P.4.5.1.s Field strength and direction are determined using a suitable test particle. (Notes: 1) Calculations are	Electricity	Electric Forces and Fields

			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.	Physics and the Laws of Motion Electricity Magnetism and Atomic Physics	Two Dimensional Motion and Vectors Electric Forces and Fields Magnetism
			P.4.5.1.u The inverse square law applies to electrical and gravitational fields produced by point sources.	Energy and Motion Electricity	Circular Motion and Gravitation Electric Forces and Fields
			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).	Magnetism and Atomic Physics Magnetism and Atomic Physics	Atomic Physics Photoelectric Effect Lab
			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 appears as fractional values of the elementary charge (quarks).		
			P.4.5.3.c On the atomic level, energy is emitted or absorbed in discrete packets called photons.	Magnetism and Atomic Physics Magnetism and	Atomic Physics Photoelectric Effect Lab

				Atomic Physics	
			P.4.5.3.d The energy of a photon is proportional to its frequency.	Magnetism and Atomic Physics Magnetism and Atomic Physics	Atomic Physics Photoelectric Effect Lab
			P.4.5.3.e On the atomic level, energy and matter exhibit the characteristics of both waves and particles.	Magnetism and Atomic Physics Magnetism and Atomic Physics	Atomic Physics Photoelectric Effect Lab
			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.		
			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	Physics and the Laws of Motion Physics and the Laws of Motion Physics and the Laws of Motion	Free Fall Acceleration Lab Projectile Motion Lab Forces and Friction Lab

				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and	Photoelectric Effect Lab

				Atomic Physics	
			P.6.2.4 Compare predictions to actual observations, using test models.	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab
				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab

				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
			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	Physics and the Laws of Motion	Free Fall Acceleration Lab
				Physics and the Laws of Motion	Projectile Motion Lab
				Physics and the Laws of Motion	Forces and Friction Lab
				Energy and Motion	Conservation of Mechanical Energy Lab
				Energy and Motion	Momentum Lab
				Energy and Motion	Machines and Efficiency Lab
				Heat and Thermodynamics	Thermal Equilibrium Lab
				Heat and Thermodynamics	Piston Lab

				Waves	Simple Harmonic Motion Lab
				Waves	Wave Lab
				Waves	Sound Lab
				Waves	Converging Lenses Lab
				Electricity	Electrostatics Lab
				Electricity	Current and Resistance Lab
				Electricity	Resistors in Series and Parallel Lab
				Magnetism and Atomic Physics	Magnetic Field of a Solenoid Lab
				Magnetism and Atomic Physics	Electromagnetic Induction Lab
				Magnetism and Atomic Physics	Photoelectric Effect Lab
		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	**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		

		behavior and design of systems.			
		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.		
			P.6.4.2 Cite specific examples of how dynamic equilibrium is achieved by equality of change in opposing directions.		
		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.	Physics and the Laws of Motion	Free Fall Acceleration Lab
			P.6.5.1.a predict the behavior of physical systems, using mathematical models such as graphs and equations		
			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	**P.7.1** The knowledge and skills	**P.7.1.1** address real-world problems, using scientific methodology		

	mathematics, science, and technology to address real-life problems and make informed decisions.	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.7.2 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.	**P.7.2.1** collect, analyze, interpret, and present data, using appropriate tools		
			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		