

**Correlation to Massachusetts Science and Technology Curriculum Framework
Foundations of Physical Science Student Text and Investigation Manual**

Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
CHM.01.01 Physical Sciences /Chemistry	High School	Properties of Matter	Identify and explain some of the physical properties that are used to classify matter, e.g., density, melting point, and boiling point.	278	mixtures can be separated by physical means	114	separating a homogeneous mixture
				284	melting and boiling points	119	melting point of ice
				284	melting and boiling point explained	124	build a density column
				285	table of melting and boiling points		
				291	density is independent of amount of substance		
				291	density explained		
				292	hardness is a physical property of matter		
				292	elasticity is a physical property of matter		
				293	brittleness is a physical property of matter		
				294	development of Kevlar brand fiber		
				294	tensile strength is a physical property of matter		
				294	malleability is a physical property of matter		
				296	density of liquid water vs. ice		
				297	buoyancy explained		
				298	sinking and floating		
				302	viscosity of motor oils		

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				305	viscosity of glue mixtures		
CHM.01.02 Physical Sciences /Chemistry	High School	Properties of Matter	Explain the difference between mixtures and pure substances.	278	compounds are composed of elements	114	investigating a mixture
				278	pure substances cannot be separated by physical means	114	separating a homogeneous mixture
				278	mixtures can be separated by physical means	114	investigate a homogeneous mixture
				279	summary of matter classification	140	why do atoms form chemical bonds?
				283	atoms and molecules	141	compare and contrast elements and compounds
				288	create a poster of matter classification	142	why do atoms combine in certain ratios?
						165	investigate solutions and colloids and suspensions
CHM.01.03 Physical Sciences /Chemistry	High School	Properties of Matter	Describe the four states of matter (solid, liquid, gas, plasma) in terms of energy, particle motion, and phase transitions.	284	states of matter and arrangement of molecules	118	observe melting process and study quantitatively
				284	changes of state	118	molecules in a liquid
				285	characteristics of matter related to its state	118	investigate melting
				286	plasma is a fourth state of matter	119	investigate melting and create a graph
				286	where do you find plasma?	119	create a temperature vs. time graph of phase change
						119	energy and phase changes

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CHM.01.04 Physical Sciences /Chemistry	High School	Properties of Matter	Distinguish between chemical and physical changes.	353	physical and chemical changes and digestion	146	investigate and observe chemical and physical changes in the lab
				355	physical and chemical changes in tire recycling		
				372	determine if changes are chemical or physical		
CHM.02.01 Physical Sciences /Chemistry	High School	Atomic Structure	Trace the development of atomic theory and the structure of the atom from the ancient Greeks to the present (Dalton, Thompson, Rutherford, Bohr, and modern theory).	311	protons/neutrons/electrons	130	investigate Rutherford's gold foil experiment
				311	location/size/charge of subatomic particles	132	atomic number determines what element that atom is
				312	contributions of Fermi	132	building atom models
				313	development of atomic theory	133	location of electrons in atom
				315	atoms of same element have same atomic number	133	protons and neutrons
				318	proton/electron attraction	136	model stable and neutral atoms
				324	research and create a poster to illustrate development of atomic model	137	importance of atomic number
				388	showing valence electrons in a diagram	137	build atomic models
				393	contributions of Marie and Pierre Curie	140	find the number of electrons in outermost level
						140	review subatomic particles

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CHM.02.03 Physical Sciences /Chemistry	High School	Atomic Structure	Identify the major components of the nuclear atom (protons, neutrons, and electrons) and explain how they interact.	311	protons/neutrons/electrons	132	atomic number determines what element that atom is
				311	location/size/charge of subatomic particles	132	building atom models
				315	atoms of same element have same atomic number	133	location of electrons in atom
				318	proton/electron attraction	133	protons and neutrons
				324	which element is more likely to combine with other elements?	136	model stable and neutral atoms
				324	use the periodic table to predict chemical formulas	137	importance of atomic number
				335	chemical bonding and the periodic table	137	build atomic models
				388	showing valence electrons in a diagram	140	find the number of electrons in outermost level
						140	review subatomic particles
						141	modeling a chemical bond
CHM.02.04 Physical Sciences /Chemistry	High School	Atomic Structure	Understand that matter has properties of both particles and waves.	195	waves transmit energy	132	comparing atoms
				311	all matter is formed from atoms		
				311	all matter is formed from atoms		
				474	energy and radiation relationships		

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CHM.02.06 Physical Sciences /Chemistry	High School	Atomic Structure	Describe the electromagnetic spectrum in terms of wavelength and energy; identify regions of the electromagnetic spectrum.	196 237 237 237 237 250 272 474	waves are all around us visible light and the electromagnetic spectrum light waves and the electromagnetic spectrum microwave ovens radio and television signals identify uses of electromagnetic waves identify uses of electromagnetic waves ultraviolet and infrared light	134	investigating visible light with a spectrometer
CHM.02.08 Physical Sciences /Chemistry	High School	Atomic Structure	Describe alpha, beta, and gamma particles; discuss the properties of alpha, beta, and gamma radiation; and write balanced nuclear reactions.	388	nuclear vs chemical reactions	138 160 160	nuclear reactions radioactive decay how do you simulate nuclear decay?
CHM.02.09 Physical Sciences /Chemistry	High School	Atomic Structure	Compare nuclear fission and nuclear fusion and mass defect.	387	fusion and fission explained	138	fusion and fission

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
CHM.02.10 Physical Sciences /Chemistry	High School	Atomic Structure	Describe the process of radioactive decay as the spontaneous breakdown of certain unstable elements (radioactive) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles.	387	fusion and fission explained	138 160	fusion and fission radioactive decay
CHM.03.01 Physical Sciences /Chemistry	High School	Periodicity	Explain the relationship of an element's position on the periodic table to its atomic number and mass.	315 316 321 322 322 322 322	atomic number discussed mass number discussed studying the periodic table chemical symbols and element names atomic number on the periodic table mass number on the periodic table atomic mass on the periodic table	133 133 133 136 136 136	identify mass number identify element symbol and name identify atomic number building and studying the periodic table atomic number mass number

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CHM.03.02 Physical Sciences /Chemistry	High School	Periodicity	Use the periodic table to identify metals, nonmetals, metalloids, families (groups), periods, valence electrons, and reactivity with other elements in the table.	320 321 332	groups of elements studying the periodic table metals nonmetals and metalloids	133 136	using the periodic table building and studying the periodic table
CHM.03.04 Physical Sciences /Chemistry	High School	Periodicity	Identify trends on the periodic table (ionization energy, electronegativity, electron affinity, and relative size of atoms and ions).	321 321 329 330 332 335	studying the periodic table groups of elements and valence shells periodic table columns and valence electrons bonding and periodic table position periodic table and electronegativities periodic table and oxidation numbers	136 141 142	building and studying the periodic table build model of Na and Cl atoms and explain why they bond to form a molecule arrangement of electrons and groups of elements

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
CHM.04.01 Physical Sciences /Chemistry	High School	Chemical Bonding	Explain how atoms combine to form compounds through both ionic and covalent bonding.	324	which element is more likely to combine with other elements?	141	modeling a chemical bond
				324	use the periodic table to predict chemical formulas	143	classify ionic compounds
				330	ionic bonds	143	ionic compounds
				331	covalent bonds		
				332	distinguishing between ionic and covalent bonds		
				335	chemical bonding and the periodic table		
CHM.04.02 Physical Sciences /Chemistry	High School	Chemical Bonding	Draw Lewis dot structures for simple molecules.	330	Lewis Dot diagrams		
CHM.04.06 Physical Sciences /Chemistry	High School	Chemical Bonding	Predict chemical formulas based on the number of valence electrons.	336	writing chemical formulas	140	find the number of electrons in outermost level
				368	predicting amount of product	155	calculating product yield
				388	showing valence electrons in a diagram		
CHM.04.07 Physical Sciences /Chemistry	High School	Chemical Bonding	Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain common polyatomic ions.	336	writing a chemical formula	143	predict chemical formulas
				338	summary of chemical formula writing rules	143	name chemical compounds
				339	naming compounds	145	determine empirical formula
				344	calculating formula mass	148	chemical equations
				349	calculate the formula mass		

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CHM.05.01 Physical Sciences /Chemistry	High School	Chemical Reactions and Stoichiometry	Balance chemical equations by applying the law of conservation of mass.	363 371	history of law of conservation of mass which of the equations is balanced?	149 150	balance these equations investigate conservation of mass in effervescent tablet reaction
CHM.05.02 Physical Sciences /Chemistry	High School	Chemical Reactions and Stoichiometry	Recognize synthesis, decomposition, single displacement, double displacement, and neutralization reactions.	375 376 377 377	synthesis or addition reactions decomposition reactions double displacement reactions single displacement reactions	156	investigate double displacement reactions
CHM.05.03 Physical Sciences /Chemistry	High School	Chemical Reactions and Stoichiometry	Understand the mole concept in terms of number of particles, mass, and gaseous volume.	343	what is a mole?		
CHM.05.04 Physical Sciences /Chemistry	High School	Chemical Reactions and Stoichiometry	Determine molar mass, percent compositions, empirical formulas, and molecular formulas.	336 343 368 371	writing chemical formulas what is a mole? predicting amount of product which of the equations is balanced?	149 155	balance these equations calculating product yield
CHM.05.06 Physical Sciences /Chemistry	High School	Chemical Reactions and Stoichiometry	Calculate percent yield in a chemical reaction.	336 364 368	writing chemical formulas formation of petroleum is a very slow chemical reaction predicting amount of product	155 156	calculating product yield predict products in a double displacement reaction

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CHM.06.01 Physical Sciences /Chemistry	High School	Gases and Kinetic Molecular Theory	Using the kinetic molecular theory, explain the relationship between pressure and volume (Boyle' s law), volume and temperature (Charles' law), and the number of particles in a gas sample (Avogadro' s hypothesis).	299 300 300 451	Charles' law what is pressure? Boyle's law temperature and kinetic energy		
CHM.06.02 Physical Sciences /Chemistry	High School	Gases and Kinetic Molecular Theory	Explain the relationship between temperature and average kinetic energy.	451	temperature and kinetic energy		
CHM.06.06 Physical Sciences /Chemistry	High School	Gases and Kinetic Molecular Theory	Use the combined gas law to determine changes in pressure, volume, or temperature.	300	what is pressure?		
CHM.07.01 Physical Sciences /Chemistry	High School	Solutions	Describe the process by which solutes dissolve in solvents.			167 167	investigate the dissolving process what happened at the molecular level?

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
CHM.07.02 Physical Sciences /Chemistry	High School	Solutions	Identify and explain the factors that affect the rate of dissolving, i.e., temperature, concentration, and mixing.	364	formation of petroleum is a very slow chemical reaction	156	predict products in a double displacement reaction
				406	molecular motion and dissolving rate	166	design experiments to explore dissolving rate
				406	molecular motion and dissolving rate	168	investigate solubility of sugar
				407	surface area and dissolving rate	170	solubility and pressure
				411	effect of temperature on solubility	170	solubility and temperature
				413	pressure and the solubility of gases		
				421	why water is a nearly universal solvent		
				423	polar solutes		
CHM.07.03 Physical Sciences /Chemistry	High School	Solutions	Describe the dynamic equilibrium that occurs in saturated solutions.	51	what is equilibrium?		
CHM.07.04 Physical Sciences /Chemistry	High School	Solutions	Calculate concentration in terms of molarity, molality, and percent by mass.			167	investigate the dissolving process
						167	what happened at the molecular level?
CHM.07.05 Physical Sciences /Chemistry	High School	Solutions	Use a solubility curve to determine saturation values at different temperatures.	411	effect of temperature on solubility	168	investigate solubility of sugar
						170	solubility and temperature

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CHM.08.01 Physical Sciences /Chemistry	High School	Acids and Bases	Define Arrhenius' theory of acids and bases in terms of the presence of hydronium and hydroxide ions, and Bronsted's theory of acids and bases in terms of proton donor and acceptor, and relate their concentrations to the pH scale.	437 440 443	concentration of ions and pH examples of acid and base chemistry pH and blood	176 176	investigate acids and bases measure pH of everyday solutions
CHM.08.02 Physical Sciences /Chemistry	High School	Acids and Bases	Compare and contrast the nature, behavior, concentration and strength of acids and bases. a. Acid-base neutralization b. Degree of dissociation or ionization c. Electrical conductivity	437 440 443	concentration of ions and pH examples of acid and base chemistry pH and blood	176 176	investigate acids and bases measure pH of everyday solutions
CHM.08.06 Physical Sciences /Chemistry	High School	Acids and Bases	Calculate the pH or pOH of aqueous solutions using the hydronium or hydroxide ion concentration.	437 440 443	concentration of ions and pH examples of acid and base chemistry pH and blood	176 176	measure pH measure pH of everyday solutions

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
CHM.10.01 Physical Sciences /Chemistry	High School	Thermochemistry (Enthalpy)	Interpret the law of conservation of energy.	88 90 92 93 96	potential and kinetic energy explained conservation of energy explained energy transformations and conservation different forms of energy described prove that energy is conserved	37 38 188	investigating conservation of energy with rollercoaster conservation of energy and energy transformations specific heat and conservation of energy
ESS.02.02 Earth and Space Science	High School	The Earth's Sources of Energy	Explain the advantage and limitations of renewable sources of energy.	172 391 391 400 444	generating electric power nuclear vs. fossil fuels impact of nuclear energy reducing pollution impact of using fossil fuels	52 201	the cost of using electrical appliances investigate different methods of generating electricity
ESS.02.03 Earth and Space Science	High School	The Earth's Sources of Energy	Explain the advantage and limitations of nonrenewable sources of energy.	172 391 391 400 444	generating electric power nuclear vs. fossil fuels impact of nuclear energy reducing pollution impact of using fossil fuels	52 201	the cost of using electrical appliances investigate different methods of generating electricity

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ESS.02.04 Earth and Space Science	High School	The Earth's Sources of Energy	Describe ways in which people have tried to control the use of renewable and nonrenewable sources of energy, e.g., scientific advances, prices.	391 444	nuclear vs. fossil fuels impact of using fossil fuels		
ESS.02.05 Earth and Space Science	High School	The Earth's Sources of Energy	Describe the effects on the environment of using both renewable and nonrenewable sources of energy.	391 391 400 444	nuclear vs. fossil fuels impact of nuclear energy reducing pollution impact of using fossil fuels	52	the cost of using electrical appliances
ESS.02.06 Earth and Space Science	High School	The Earth's Sources of Energy	Describe ways in which scientists are addressing effects on the environment of using both renewable and nonrenewable sources of energy, e.g., creation of new technologies.	391 400	impact of nuclear energy reducing pollution	52	the cost of using electrical appliances
INQ.01 Earth and Space Science	High School	Inquiry	Pose questions and state hypotheses based on prior scientific experiences.	10	the research question and hypothesis	6 166 198	how do we ask questions and get answers from nature? which method will give fastest dissolving rate? which type of food contains the most energy?

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INQ.02 Earth and Space Science	High School	Inquiry	Distinguish between hypothesis and theory as scientific terms.	10	process of reviewing hypothesis explained	39 151 167	vocabulary is presented in context of investigations review energy theory in context of everyday scenarios review your hypothesis did you prove or disprove your hypothesis?

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INQ.04 Inquiry and Experimentation	High School	Inquiry	Use mathematics to analyze and support findings and to model conclusions.	24	making a graph	13	graph distance vs. time
				24	interpretations of patterns in data	15	construct a quantitative graphical model
				26	creating graphs	15	interpret a speed vs. time graph
				27	reading a graph	25	create a mathematical model
				41	make a graph	27	find math rule for lever equilibrium
				42	interpreting distance/time graph	28	derive a math formula
				78	analyze lever diagram	37	organize data into a graph of speed vs. height
						51	graph voltage vs. current
						121	graph mass vs. volume
						129	find average velocity
						147	organize observations into a category table
						151	does your experiment agree with law of conservation of mass?
						167	average dissolving rate
						181	construct a graphical model
		183	construct a temperature vs. time graph				

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
INQ.05 Inquiry and Experimentation	High School	Inquiry	Simulate physical processes or phenomena using different kinds of representations.	9 10 19	steps in the scientific method forming a hypothesis design your own experiment	7 7 9 10 10 12 16 30 34 40 75 75 145 151	compare results with hypothesis perform your own experiment conduct three experiments with appropriate equipment selecting ramp and photogates conduct car/ramp experiment select equipment and set up experiment investigate Newton's 2nd law rigging block and tackle investigate motion on a rollercoaster choose circuit parts to light a bulb plan three experiments to determine which variable affects the period of a pendulum perform self-designed experiment carry out procedure and select equipment select materials from list

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						166	which factor will produce fastest dissolving rate?
INQ.06 Inquiry and Experimentation	High School	Inquiry	Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.	11	controlling variables in experiments	7	what variables should be controlled?
				19	did you run a controlled experiment?	11	calculate % error
				20	what factors could explain the variability in their data?	76	calculate % error
						129	control the height of the liquid
						151	does your experiment agree with law of conservation of mass?
						165	what does the word "control" mean?
						165	why was plain water tested?
INQ.07 Inquiry and Experimentation	High School	Inquiry	Revise scientific models.			157	add new rules to list based on findings

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INQ.08 Inquiry and Experimentation	High School	Inquiry	Communicate and defend a scientific argument.	20	explain your reasoning	9	present conclusions to the class
						9	reporting on an experiment
						21	construct reasonable explanation based on data
						35	study data and determine importance of height on speed of marble
						37	describe the flow of energy based on experimental graph
						39	give a brief presentation to the class
						45	analyze data and explain a rule
						47	present and defend an explanation
						145	present findings to the class
						145	present findings and methods used
						145	present findings to the class
						151	present results to the class
						173	write paragraph to explain results
						175	create water quality report

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						179	write summary of findings
PHY.01.03 Physical Sciences/ Physics	High School	Motion and Forces	Distinguish between, and solve problems involving, velocity, speed, and constant acceleration.	14	how to calculate speed	8	calculating speed
				15	compare and contrast speed and velocity	9	collect data and calculate speed of car
				20	calculate speed of car	10	calculate speed of the car
				20	find speed of bumblebee	12	calculate speed of moving car
				24	accurate speed measurements	12	find speed of car at different positions
				32	average speed vs. instantaneous	14	calculate acceleration of car on ramp
				32	average speed discussed	14	acceleration is the rate at which speed changes
				33	understanding acceleration	14	calculate speed of car at two places on the ramp
				35	how to calculate acceleration	17	explore 2nd law and acceleration
				36	examples of acceleration	17	calculate speed of car
				41	find acceleration of car	36	find speed of marble
				42	calculate speed from distance/time graph		
				49	link between force and acceleration		
				53	acceleration due to gravity		

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PHY.01.04 Physical Sciences/ Physics	High School	Motion and Forces	Create and interpret graphs of motion (position vs. time, speed vs. time, velocity vs. time, constant acceleration vs. time).	29 30 37 37	position vs. time graph discussion position vs. time graphs speed vs. time graphs speed vs. time graph discussion	12 13 15 15	model the car's motion graphically make a position vs. time graph make a speed vs. time graph changes in motion can be represented graphically
PHY.01.06 Physical Sciences/ Physics	High School	Motion and Forces	Interpret and apply Newton's first law of motion.	45 48	Newton's first law summarized Newton's first law in detail	14	exploring acceleration on a ramp
PHY.01.07 Physical Sciences/ Physics	High School	Motion and Forces	Interpret and apply Newton's second law of motion to show how an object's motion will change only when a net force is applied.	45 49 64	Newton's second law summarized Newton's second law in detail solving problems using $f=ma$	16 19	thinking about force discover 2nd law of motion
PHY.01.08 Physical Sciences/ Physics	High School	Motion and Forces	Use a free body force diagram with only co-linear forces to show forces acting on an object, and determine the net force on it.	51	net force explained	22	car and ramp and Newton's 3rd law

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PHY.01.09 Physical Sciences/ Physics	High School	Motion and Forces	Qualitatively distinguish between static and kinetic friction, what they depend on and their effects on the motion of objects.	56 64	friction explained research effect of friction on human joints	21	effect of friction on the car
PHY.01.10 Physical Sciences/ Physics	High School	Motion and Forces	Interpret and apply Newton's third law of motion.	45 59	Newton's third law summarized Newton's third law in detail	22 23	car and ramp and Newton's 3rd law using 3rd law to explain common phenomena
PHY.01.11 Physical Sciences/ Physics	High School	Motion and Forces	Understand conceptually Newton's law of universal gravitation.	52 54 55	gravity depends on mass Newton's law of universal gravitation calculating gravitational force between objects		
PHY.01.12 Physical Sciences/ Physics	High School	Motion and Forces	Identify appropriate standard international units of measurement for force, mass, distance, speed, acceleration, and time, and explain how they are measured.	3 6 19 78	time measurement scientists use metric units convert from english to metric use and understand mass measurements	12 16 116	make metric length measurement understand and use units of force measuring mass

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PHY.02.01 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Interpret and provide examples that illustrate the law of conservation of energy.	60 88 90 90 92 93 96 363 363	conservation of momentum potential and kinetic energy explained conservation of energy conservation of energy explained energy transformations and conservation different forms of energy described prove that energy is conserved conservation of mass conservation of mass	36 36 37 38 150 188	investigate energy conservation energy conservation and the roller coaster investigating conservation of energy with rollercoaster conservation of energy and energy transformations investigate conservation of mass specific heat and conservation of energy
PHY.02.02 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Provide examples of how energy can be transformed from kinetic to potential and vice versa.	91	following an energy transformation	36 38	energy conservation and the roller coaster identify potential/kinetic energy conversions
PHY.02.03 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Apply quantitatively the law of conservation of mechanical energy to simple systems.			36	energy conservation and the roller coaster

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PHY.02.04 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Describe the relationship among energy, work, and power both conceptually and quantitatively	68	compound machines	29	design and construct complex gear machines
				83	how to calculate work	31	calculate work done on block
				86	how to calculate power		
				86	power explained		
				87	concept of energy as stored work		
				96	calculate work done		
				97	calculate work accomplished by a motor		
				97	compare different amounts of work done		
				97	analyze power of motor		
				97	calculate power of two different machines		
				97	calculate power		
				138	how to calculate electrical power		
				488	work vs. calories used by the body		
				488	work vs. calories used by the body		
				491	work and mechanical systems		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.02.05 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Interpret the law of conservation of momentum and provide examples that illustrate it. Calculate the momentum of an object.	60	law of conservation of momentum		
				60	how to calculate momentum		
				64	calculate momentum		

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PHY.02.06 Physical Sciences/ Physics	High School	Conservation of Energy and Momentum	Identify appropriate standard international units of measurement for energy, work, power, and momentum.	83	how to calculate work	31	calculate work done on block
				86	how to calculate power		
				86	power explained	31	work = force X distance
				87	concept of energy as stored work		
				96	calculate work done		
				96	decide whether or not work is done		
				97	calculate work accomplished by a motor		
				97	compare different amounts of work done		
				97	analyze power of motor		
				97	calculate power of two different machines		
				97	calculate power		
				138	how to calculate electrical power		
				488	work vs. calories used by the body		
				488	work vs. calories used by the body		
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PHY.03.01 Physical Sciences/ Physics	High School	Heat and Heat Transfer	Relate thermal energy to molecular motion.	451 451	increasing temperature means increasing motion of molecules temperature and kinetic energy	119	adding heat energy to melt an ice cube
PHY.03.02 Physical Sciences/ Physics	High School	Heat and Heat Transfer	Differentiate between specific heat and heat capacity.	457 458 459	specific heat and the heat equation specific heat specific heat of different substances		
PHY.03.03 Physical Sciences/ Physics	High School	Heat and Heat Transfer	Explain the relationship among temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.	457 458 459	specific heat and the heat equation specific heat specific heat of different substances	119	investigate temperature and energy transfer in melting process

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.03.04 Physical Sciences/ Physics	High School	Heat and Heat Transfer	Recognize that matter exists in four phases, and explain what happens during a phase change.	284	melting and boiling points	118	observe melting process and study quantitatively
				284	melting and boiling point explained	118	molecules in a liquid
				284	states of matter and arrangement of molecules	118	investigate melting
				284	changes of state	119	melting point of ice
				285	table of melting and boiling points	119	investigate melting and create a graph
				285	characteristics of matter related to its state	119	create a temperature vs. time graph of phase change
						119	energy and phase changes
PHY.04.01 Physical Sciences/ Physics	High School	Waves	Differentiate between wave motion (simple harmonic nonlinear motion) and the motion of objects (nonharmonic).	180	oscillators explained	82	study wave pulses on elastic cord
				184	understanding graphs of harmonic motion	84	make different types of waves in a ripple tank
				195	waves transmit energy		
				197	transverse and longitudinal waves		
				205	standing waves on a string		
				474	energy and radiation relationships		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.04.02 Physical Sciences/ Physics	High School	Waves	Recognize the measurable properties of waves (e.g., velocity, frequency, wavelength) and explain the relationships among them.	179 182 182 192 198 215 219 221 242	what is a cycle? concept of frequency explained concept of period explained analyze systems to find cycle/period/frequency frequency and wavelength and amplitude properties of sound waves frequency of sound and pitch importance of wavelength of sound waves properties of light waves	83 83 86 86 90	measure speed of a wave pulse find speed of a wave investigate frequency and wavelength adjust frequency of a standing wave what is sound and how do we hear it?
PHY.04.03 Physical Sciences/ Physics	High School	Waves	Distinguish between transverse and longitudinal waves	197 205	transverse and longitudinal waves standing waves on a string	82 84	study wave pulses on elastic cord make different types of waves in a ripple tank
PHY.04.04 Physical Sciences/ Physics	High School	Waves	Distinguish between mechanical and electromagnetic waves.	474	electromagnetic radiation		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.04.05 Physical Sciences/ Physics	High School	Waves	Interpret and be able to apply the laws of reflection and refraction (qualitatively) to all waves.	201	waves and refraction	85	observing reflection in water waves
				201	reflection in water waves and light waves	107	plot reflected rays from a mirror
				201	waves and reflection		
				202	refraction and eyeglasses	107	investigate reflection of light
				245	we see color in terms of reflected light	108	tracing incident and refracted rays
				258	refraction in optical systems	108	explore refraction with a prism
				260	reflection and mirrors		
				261	refraction and lenses		
				263	index of refraction		
				263	index of refraction		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.04.06 Physical Sciences/ Physics	High School	Waves	Recognize the effects of polarization, wave interaction, and the Doppler effect.	201 201 201 201 202 206 210 223 225 240 261	waves and absorption waves and refraction reflection in water waves and light waves waves and reflection refraction and eyeglasses constructive and destructive interference can wave interference sink a ship? interference of sound waves consonance and dissonance and beats polarization of light refraction and lenses	85 95 95 101 102 102 103 108	observing reflection in water waves interference and sound waves investigate interference with sound waves examine light through diffraction grating polarization of water waves polarization of a spring wave polarization of light explore refraction with a prism
PHY.04.07 Physical Sciences/ Physics	High School	Waves	Explain, graph, and interpret graphs of constructive and destructive interference of waves.	184	understanding graphs of harmonic motion		
PHY.04.08 Physical Sciences/ Physics	High School	Waves	Explain the relationship between the speed of a wave (e.g., sound) and the medium it travels through.	197 205	transverse and longitudinal waves standing waves on a string	82 84	study wave pulses on elastic cord make different types of waves in a ripple tank

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.04.09 Physical Sciences/ Physics	High School	Waves	Recognize the characteristics of a standing wave and explain the conditions under which two waves on a string or in a pipe can interfere to produce a standing wave.	204 210	resonance explained natural frequency of a building and earthquakes	87 88 96	investigating resonance natural frequency and resonance of standing waves on a string investigating sound resonance
PHY.05.01 Physical Sciences/ Physics	High School	Electromagnetism	Recognize the characteristics of static charge, and explain how a static charge is generated.	105 106 107 108 108	charge is a fundamental property of matter static charge discussed explanation of coulomb electroscopes how an electroscope works	42	investigate electric charge
PHY.05.04 Physical Sciences/ Physics	High School	Electromagnetism	Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them.	106 106 131 132	electrical forces electrical force is incredibly strong! Ohm's law explained using Ohm's law to analyze circuits	50	Ohm's law

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.05.05 Physical Sciences/ Physics	High School	Electromagnetism	Identify appropriate units of measurement for current, voltage, and resistance, and explain how they are measured.	101	concept of electric current	44	investigate concept of voltage
				114	voltage and potential energy	46	investigate concept of electric current
				115	how to measure voltage	48	measuring resistance
				123	understand the concept of electrical resistance		
				136	potentiometer explained		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.05.06 Physical Sciences/ Physics	High School	Electromagnetism	Analyze circuits (find the current at any point and the potential difference between any two points in the circuit) using Kirchoff's and Ohm's laws.	102	concept of electric circuits	45	battery chemicals and electrical charge
				103	circuit diagrams	50	Ohm's law
				113	battery uses chemical energy to produce electrical charge	56	build a parallel circuit
				131	Ohm's law explained	56	build a series circuit
				132	using Ohm's law to analyze circuits	57	compare brightness of bulbs in series vs. parallel
				145	single path vs. branching paths	58	build a series circuit and find total resistance
				145	holiday lights as series or parallel	60	parallel circuit and Ohm's law
				145	parallel circuit defined	61	compare current and voltage and resistance in each type of circuit
				145	series circuit defined		
				146	household wiring		
				147	current and voltage in series circuits		
				151	voltage and resistance in parallel circuits		
				155	analyze a parallel circuit		
				156	analyze a series circuit		

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.06.01 Physical Sciences/ Physics	High School	Electromagnetic Radiation	Describe the electromagnetic spectrum in terms of wavelength and energy, and be able to identify specific regions such as visible light.	237 237 242 474	visible light and the electromagnetic spectrum light waves and the electromagnetic spectrum color and frequency of light waves ultraviolet and infrared light	105 134	explore relationship between color and wavelength investigating visible light with a spectrometer
PHY.06.02 Physical Sciences/ Physics	High School	Electromagnetic Radiation	Explain how the various wavelengths in the electromagnetic spectrum have many useful applications such as radio, television, microwave appliances, and cellular telephones.	196 237 237 250 272	waves are all around us microwave ovens radio and television signals identify uses of electromagnetic waves identify uses of electromagnetic waves		
PHY.06.03 Physical Sciences/ Physics	High School	Electromagnetic Radiation	Calculate the frequency and energy of an electromagnetic wave from the wavelength.	195 242 474	waves transmit energy color and frequency of light waves energy and radiation relationships	105	explore relationship between color and wavelength

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Standard #: Strand	Grade	Topic	Learning Standard	student text pg	detail	investigation pg	detail
PHY.06.04 Physical Sciences/ Physics	High School	Electromagnetic Radiation	Recognize and explain the ways in which the direction of visible light can be changed.	245	we see color in terms of reflected light	101	observing white light through diffraction grating
				258	refraction in optical systems	106	tracing incident and reflected rays
				258	forming images with lenses	107	investigate how light interacts with mirrors
				260	reflection and mirrors	107	plot reflected rays from a mirror
				263	index of refraction	107	investigate reflection of light
				263	index of refraction	107	investigate reflection of light
				268	total internal reflection and fiber optics	108	tracing incident and refracted rays
				273	find the angle of reflection	108	investigate how light interacts with a prism
				476	absorption and emission	108	explore refraction with lenses
						110	finding focal point and focal length of a lens
						111	plotting images formed when light is refracted by a lens
						113	observe internal reflection and relate to fiber optics