

Correlation to California Science Content Standards
Foundations of Physical Science Student Text and Investigation Manual

Standard #: Subject	Topic	Standard	Benchmark	Volume 1 Student Text page		Volume 2 Investigation Manual page	
ChemHS.01.a Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.	311	location/size/charge of subatomic particles	132	atomic number determines what element that atom is
				311	protons/neutrons/electrons	133	using the periodic table
				315	atomic number discussed	133	identify mass number
				315	atoms of same element have same atomic number	133	identify atomic number
				316	mass number discussed	133	identify element symbol and name
				320	groups of elements	133	location of electrons in atom
				321	studying the periodic table	133	protons and neutrons
				322	atomic mass on the periodic table	136	building and studying the periodic table
				322	mass number on the periodic table	136	mass number
				322	atomic number on the periodic table	136	atomic number
				322	chemical symbols and element names	137	build atomic models
				332	metals nonmetals and metalloids	137	importance of atomic number
						140	review subatomic particles

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ChemHS.01.b Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to use the periodic table to identify metals, semimetals, non-metals, and halogens.	320 groups of elements 332 metals nonmetals and metalloids	133 using the periodic table
ChemHS.01.c Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	321 groups of elements and valence shells 324 use the periodic table to predict chemical formulas 324 which element is more likely to combine with other elements? 329 periodic table columns and valence electrons 330 bonding and periodic table position 332 periodic table and electronegativities 335 periodic table and oxidation numbers 335 chemical bonding and the periodic table	136 ions 141 build model of Na and Cl atoms and explain why they bond to form a molecule 141 when an atom ionizes 141 modeling a chemical bond 142 arrangement of electrons and groups of elements 143 ionic compounds

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ChemHS.01.d Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to use the periodic table to determine the number of electrons available for bonding.	320	groups of elements	133	using the periodic table
				324	use the periodic table to predict chemical formulas	136	ions
				324	which element is more likely to combine with other elements?	140	find the number of electrons in outermost level
				330	Lewis Dot diagrams	141	when an atom ionizes
				335	chemical bonding and the periodic table	141	modeling a chemical bond
				388	showing valence electrons in a diagram	143	ionic compounds
ChemHS.01.e Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.	311	location/size/charge of subatomic particles	130	investigate Rutherford's gold foil experiment
				311	protons/neutrons/electrons	132	building atom models
				313	development of atomic theory	133	location of electrons in atom
				318	proton/electron attraction	133	protons and neutrons
				324	research and create a poster to illustrate development of atomic model	136	model stable and neutral atoms
				137	build atomic models		
					140	review subatomic particles	

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ChemHS.01.f Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.	312	Dalton's contributions	
				321	Mendeleev's periodic table	
				332	Linus Pauling and electronegativities	
				363	Antoine Lavoisier	
				393	accomplishments of Marie Curie	
				393	Marie and Pierre Curie	

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ChemHS.01.g Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.	321	groups of elements and valence shells	136	ions
				329	periodic table columns and valence electrons	140	find the number of electrons in outermost level
				330	ionic bonds	141	build model of Na and Cl atoms and explain why they bond to form a molecule
				330	bonding and periodic table position		
				331	covalent bonds	141	when an atom ionizes
				332	distinguishing between ionic and covalent bonds	142	arrangement of electrons and groups of elements
				332	periodic table and electronegativities	143	classify ionic compounds
				335	periodic table and oxidation numbers	143	predict chemical formulas
				336	writing a chemical formula	144	show ratios in which elements combine to form a compound
				338	summary of chemical formula writing rules	145	determine empirical formula
				343	mole quantities		
				388	showing valence electrons in a diagram		

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ChemHS.01.h Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment and Einstein's explanation of the photoelectric effect.	313	development of atomic theory	130 investigate Rutherford's gold foil experiment
				324	research and create a poster to illustrate development of atomic model	
				370	research Lavoisier's contributions	
				400	research the Clean Air Act of 1970 and 1990	
ChemHS.01.l Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.	434	research local water supply history	130 investigate Rutherford's gold foil experiment 140 find the number of electrons in outermost level
				312	Dalton's contributions	
				313	development of atomic theory	
				321	Mendeleev's periodic table	
				324	research and create a poster to illustrate development of atomic model	
				332	Linus Pauling and electronegativities	
				363	Antoine Lavoisier	
388	showing valence electrons in a diagram					
393	accomplishments of Marie Curie					
393	Marie and Pierre Curie					

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ChemHS.01.j Chemistry	Atomic and Molecular Structure	The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	Students know that spectral lines are results of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E=h\nu$).	234 electrons and energy levels and light emission	134 what does atomic structure have to do with light and color?
ChemHS.02.a Chemistry	Chemical Bonds	Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging to form ionic bonds.	321 groups of elements and valence shells 324 use the periodic table to predict chemical formulas 324 which element is more likely to combine with other elements? 329 periodic table columns and valence electrons 330 bonding and periodic table position 332 periodic table and electronegativities 335 periodic table and oxidation numbers 335 chemical bonding and the periodic table	136 ions 141 build model of Na and Cl atoms and explain why they bond to form a molecule 141 when an atom ionizes 141 modeling a chemical bond 142 arrangement of electrons and groups of elements 143 ionic compounds

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ChemHS.02.b Chemistry	Chemical Bonds	Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	Students know chemical bonds between atoms in molecules such as , H ₂ , CH ₄ , NH ₃ , H ₂ CCH ₂ , N ₂ , Cl ₂ and many large biological molecules are covalent.	321 groups of elements and valence shells 329 periodic table columns and valence electrons 330 bonding and periodic table position 332 periodic table and electronegativities 335 periodic table and oxidation numbers 364 carbon chains 394 photosynthesis and carbon reactions 395 fossil fuels and carbon reactions	141 build model of Na and Cl atoms and explain why they bond to form a molecule 142 arrangement of electrons and groups of elements 143 ionic compounds 162 carbon reactions and the environment 162 structure of fossil fuels 162 importance of fossil fuels
ChemHS.02.c Chemistry	Chemical Bonds	Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	Students know salt crystals such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.	389 electromagnetic force 389 strong nuclear force 389 forces in the nucleus	136 ions 136 strong force 141 when an atom ionizes 143 ionic compounds

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ChemHS.02.e Chemistry	Chemical Bonds	Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	Students know how to draft Lewis dot structure	330 Lewis Dot diagrams	
ChemHS.02.g Chemistry	Chemical Bonds	Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	Students know how electronegativity and ionization energy relate to bond formation.	311 location/size/charge of subatomic particles 311 protons/neutrons/electrons 324 use the periodic table to predict chemical formulas 324 which element is more likely to combine with other elements? 335 chemical bonding and the periodic table	133 location of electrons in atom 133 protons and neutrons 136 ions 137 build atomic models 140 review subatomic particles 141 when an atom ionizes 141 modeling a chemical bond

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ChemHS.03.a Chemistry	Conservation of Matter and Stoichiometry	The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.	Students know how to describe chemical reactions by writing balanced equations.	371	which of the equations is balanced?	149	balance these equations
ChemHS.04.a Chemistry	Gases and Their Properties	The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gasses.	Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.	299 300	Charles' law Boyle's law		
ChemHS.04.b Chemistry	Gases and Their Properties	The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gasses.	Students know the random motion of molecules explain the diffusion of gases.	284	states of matter and arrangement of molecules	118 118	molecules in a liquid investigate melting

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ChemHS.04.c Chemistry	Gases and Their Properties	The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gasses.	Students know how to apply the gas laws to relations between the pressure, temperature and volume of any amount of an ideal gas or any mixture of ideal gases.	299 300	Charles' law Boyle's law	
ChemHS.04.g Chemistry	Gases and Their Properties	The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gasses.	Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.	451	temperature and kinetic energy	
ChemHS.05.a Chemistry	Acids and Bases	Acids, bases, and salts are three classes of compounds that form ions in water solution.	Students know the observable properties of acids, bases and salt solution.	437 440 443	concentration of ions and pH examples of acid and base chemistry pH and blood	176 measure pH 176 investigate acids and bases 176 measure pH of everyday solutions
ChemHS.05.b Chemistry	Acids and Bases	Acids, bases, and salts are three classes of compounds that form ions in water solution.	Students know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.	437 440 443	concentration of ions and pH examples of acid and base chemistry pH and blood	176 investigate acids and bases 176 measure pH of everyday solutions

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ChemHS.05.d Chemistry	Acids and Bases	Acids, bases, and salts are three classes of compounds that form ions in water solution.	Students know how to use the pH scale to characterize acid and base solutions.	437	concentration of ions and pH	176	measure pH
				440	examples of acid and base chemistry	176	investigate acids and bases
				443	pH and blood	176	measure pH of everyday solutions
ChemHS.06.a Chemistry	Solutions	Solutions are homogenous mixtures of two or more substances.	Students know the definitions of solute and solvent.	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		
				421	a water molecule is v-shaped		
				421	water structure and its function as a solvent		
				423	polar solutes		
ChemHS.06.b Chemistry	Solutions	Solutions are homogenous mixtures of two or more substances.	Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.	406	molecular motion and dissolving rate	166	design experiments to explore dissolving rate
				406	molecular motion and dissolving rate		
				407	surface area and dissolving rate		

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ChemHS.06.c Chemistry	Solutions	Solutions are homogenous mixtures of two or more substances.	Students know temperature, pressure and surface area affect the dissolving process.	411	effect of temperature on solubility	168	investigate solubility of sugar
				413	pressure and the solubility of gases	170	solubility and pressure
				421	why water is a nearly universal solvent	170	solubility and temperature
				423	polar solutes		
ChemHS.06.f Chemistry	Solutions	Solutions are homogenous mixtures of two or more substances.	Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.	278	mixtures can be separated by physical means	114	separating a homogeneous mixture
ChemHS.07.a Chemistry	Chemical Thermodynamics	Energy is exchanged or transformed in all chemical reactions and physical changes of matter.	Students know how to describe temperature and heat flow in terms of the motion of molecules or atoms).	451	temperature and kinetic energy	119	investigate temperature and energy transfer in melting process
				452	temperature scales		
CHEMHS.07.b Chemistry	Chemical Thermodynamics	Energy is exchanged or transformed in all chemical reactions and physical changes of matter.	Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.	381	exothermic reactions and MREs	158	investigate energy changes in chemical reactions
				382	endothermic reactions and cold packs	158	measure energy changes in 3 different reactions

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ChemHS.07.c Chemistry	Chemical Thermodynamics	Energy is exchanged or transformed in all chemical reactions and physical changes of matter.	Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	284	changes of state	119	create a temperature vs. time graph of phase change 119 energy and phase changes
ChemHS.07.d Chemistry	Chemical Thermodynamics	Energy is exchanged or transformed in all chemical reactions and physical changes of matter.	Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	457 458 459	specific heat and the heat equation specific heat specific heat of different substances		
ChemHS.10.a Chemistry	Organic Chemistry and Biochemistry	The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.	Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.	333 394 395 408	plastics photosynthesis and carbon reactions fossil fuels and carbon reactions capsule coating	162 162	structure of fossil fuels importance of fossil fuels

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ChemHS.10.b Chemistry	Organic Chemistry and Biochemistry	The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.	Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.	364 carbon chains	162 carbon reactions and the environment
ChemHS.11.a Chemistry	Nuclear Processes	Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion.	Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	318 proton/electron attraction 389 electromagnetic force 389 strong nuclear force 389 forces in the nucleus	132 building atom models 136 strong force 136 model stable and neutral atoms

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ChemHS.11.c Chemistry	Nuclear Processes	Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion.	Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	316	isotopes explained	133	exploring isotopes
				393	carbon dating	136	understanding isotopes
				393	radioisotopes in science and medicine	160	radioactive decay
				400	research pros and cons of nuclear technology	161	research pros and cons of uses for radioactive elements

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InqHS.01.a Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.	5 measuring distance 12 importance of reliable and accurate data collection	<p>data tables and graphs can be created on computer or graphing calculator</p> <p>4 difference between precise and accurate data</p> <p>5 measuring metric and english lengths</p> <p>6 electronic timer and release technique</p> <p>6 measure time</p> <p>7 record time interval</p> <p>9 collect speed data</p> <p>14 record three different time intervals</p> <p>16 measure force</p> <p>17 record times</p> <p>24 collect weight data</p> <p>25 collect force data</p> <p>27 write down the number of weights you use</p> <p>36 collect precise speed and height data</p> <p>44 measure voltage</p> <p>46 measure current</p> <p>48 measure resistance</p>

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					75 collect mass and amplitude data 87 measure wavelength 116 measure mass 117 measure volume 150 record data as you perform experiment 167 collect time data and record observations 180 measure temperature

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InqHS.01.b Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Identify and communicate sources of unavoidable experimental error.	11 controlling variables in experiments 12 importance of reliable and accurate data collection 19 did you run a controlled experiment? 20 what factors could explain the variability in their data?	4 difference between precise and accurate data 6 electronic timer and release technique 7 record time interval 7 what variables should be controlled? 9 collect speed data 11 calculate % error 17 record times 24 collect weight data 36 collect precise speed and height data 75 collect mass and amplitude data 76 calculate % error 129 control the height of the liquid 165 what does the word "control" mean? 165 why was plain water tested? 167 collect time data and record observations

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InqHS.01.c Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	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
						165	what does the word "control" mean?
						165	why was plain water tested?

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InqHS.01.d Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Formulate explanations by using logic and evidence.	20	finding variability in data	18	use data to describe relationship between force and motion
				28	identifying cause and effect relationships	19	use data to infer correct relationship between variables
				41	identify cause and effect	21	determine effect of increasing mass
				79	look at force data and decide the usefulness of a machine	21	construct reasonable explanation based on data
						30	interpret block and tackle data
						35	study data and determine importance of height on speed of marble
						45	analyze data and explain a rule
						141	build models of Na and Cl and use them to explain bonding
						157	add new rules to list based on findings

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InqHS.01.e Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.	42 interpreting distance/time graph	25 create a mathematical model 27 find math rule for lever equilibrium 28 derive a math formula

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InqHS.01.f Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Distinguish between hypothesis and theory as scientific terms.	9	steps in the scientific method	6	formulate hypothesis
				10	forming a hypothesis	7	perform your own experiment
				10	process of reviewing hypothesis explained	7	variables in an experiment
				19	design your own experiment	7	compare results with hypothesis
						9	devise a hypothesis
						10	conduct car/ramp experiment
						16	investigate Newton's 2nd law
						34	investigate motion on a rollercoaster
						34	formulate hypothesis
						35	what evidence is there in support of your hypothesis?
						39	critique group's explanation of energy transformations
						39	analyze energy transformations in different scenarios
						39	review energy theory in context of everyday scenarios

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					<p>75 plan three experiments to determine which variable affects the period of a pendulum</p> <p>75 perform self-designed experiment</p> <p>77 compare law of conservation of energy to motion of pendulum</p> <p>77 show how energy loss data could be applied to designing a real clock</p> <p>151 do the data support the hypothesis</p> <p>151 review your hypothesis</p> <p>166 devise hypothesis and explain</p> <p>166 which factor will produce fastest dissolving rate?</p> <p>167 did you prove or disprove your hypothesis?</p> <p>167 what was happening at molecular level?</p> <p>178 formulate hypothesis</p> <p>198 formulate hypothesis</p>

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InqHS.01.g Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Recognize the usefulness and limitations of models and theories as scientific representations of reality.	23	why make models?	13	graph distance vs. time
				24	scientific models	15	construct a quantitative graphical model
				24	what is a scientific model?	25	create a mathematical model
				24	making a graph	27	find math rule for lever equilibrium
				26	creating graphs	28	derive a math formula
				41	make a graph	37	organize data into a graph of speed vs. height
				42	interpreting distance/time graph	51	graph voltage vs. current
						121	graph mass vs. volume
						147	organize observations into a category table
						151	does your experiment agree with law of conservation of mass?
						181	construct a graphical model
						183	construct a temperature vs. time graph

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InqHS.01.j Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Recognize the issues of statistical variability and the need for controlled tests.	11 12 26	control and experimental variables writing lab procedures independent and dependent variables	7 21 27 129 151 166 167	doing a controlled experiment choose independent and dependent variables for graph recognize variables find average velocity write a procedure write a procedure average dissolving rate
InqHS.01.k Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Recognize the cumulative nature of scientific evidence.	73	impact of Da Vinci's work	6	asking questions and learning about natural world

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InqHS.01.I Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Analyze situations and solve problems that require combining and applying concepts from more than one area of science.		174 water quality testing 177 chemistry and photography

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InqHS.01.m Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources...	379	research fuel cells	52	the cost of using electrical appliances
				379	research economic impact of fuel cells	163	too much CO2
				379	hydrogen-powered cars and the environment	163	research how trees offset accumulation of CO2
				379	research fuel cells		
				379	research environmental impact of fuel cells		
				391	nuclear vs. fossil fuels		
				391	impact of nuclear energy		
				395	fossil fuels		
				400	reducing pollution		
				400	economic impact of pollution		
				400	economic impact of reducing air pollution		
				400	problems caused by airborne pollutants		
				444	impact of using fossil fuels		
				448	research economic impact of producing gases that cause acid rain		

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InqHS.01.n Investigation and Experimentation	Standard	Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop questions and perform investigations.	Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent and that the theory is sometimes wrong.	19	which group did the best experiment?	6	predict which car will move fastest
				20	finding variability in data	7	test the effect of one other variable
				79	look at force data and decide the usefulness of a machine	11	calculate % error
						18	evaluate graphs as to whether or not they show relationships between variables
						18	use data to describe relationship between force and motion
						19	use data to infer correct relationship between variables
						21	evaluate percent change for data collected
						27	think about the variables
						30	interpret block and tackle data
						34	where does the marble move the fastest?
						39	analyze energy transformations in different scenarios
						43	how did A and B tapes acquire different charge?
						75	investigate variables that affect the period of a pendulum

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					75 evaluate statistical significance 76 calculate % error 77 compare law of conservation of energy to motion of pendulum 141 build models of Na and Cl and use them to explain bonding 151 perform the experiment you designed 151 explain how hypothesis compares to results 157 add new rules to list based on findings 167 evaluate method based on data		
PhysHS.01.a Physics	Motion and Forces	Newton's law predicts the motion of most objects.	Students know how to solve problems that involve constant speed and average speed.	14 how to calculate speed 20 calculate speed of car 20 find speed of bumblebee 24 accurate speed measurements 32 average speed vs. instantaneous 42 calculate speed from distance/time graph	9 collect data and calculate speed of car 10 calculate speed of the car 12 find speed of car at different positions 14 calculate speed of car at two places on the ramp 17 calculate speed of car 36 find speed of marble		

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PhysHS.01.b Physics	Motion and Force	Newton's law predicts the motion of most objects.	Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).	45 48 51	Newton's first law summarized Newton's first law in detail balanced and unbalanced forces	14 16	exploring acceleration on a ramp unbalanced forces and acceleration of car
PhysHS.01.c Physics	Motion and Force	Newton's law predicts the motion of most objects.	Students know how to apply the law $F=ma$ to solve one-dimensional motion problems that involve constant forces (Newton's second law).	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
PhysHS.01.d Physics	Motion and Force	Newton's law predicts the motion of most objects.	Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).	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

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PhysHS.01.e Physics	Motion and Force	Newton's law predicts the motion of most objects.	Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of the Earth.	52 52 54 55	gravity depends on mass the effect of gravity Newton's law of universal gravitation calculating gravitational force between objects	20	investigate effect of gravity on motion
PhysHS.01.m Physics	Motion and Force	Newton's law predicts the motion of most objects.	Students know how to solve problems involving the forces between two electric charges at a distance (Coulomb's law) or the forces between two masses at a distance (universal gravitation).	52 54 55	gravity depends on mass Newton's law of universal gravitation calculating gravitational force between objects		
PhysHS.02.a Physics	Conservation of Energy and Momentum	The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.	Students know how to calculate kinetic energy by using the formula $E=(1/2)mv^2$.	91	following an energy transformation	36 38	energy conservation and the roller coaster identify potential/kinetic energy conversions

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PhysHS.02.c Physics	Conservation of Energy and Momentum	The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.	Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.	88	potential and kinetic energy explained	36	energy conservation and the roller coaster
				90	conservation of energy explained	37	investigating conservation of energy with rollercoaster
				92	energy transformations and conservation	38	conservation of energy and energy transformations
				93	different forms of energy described		
				96	prove that energy is conserved	188	specific heat and conservation of energy
PhysHS.02.e Physics	Conservation of Energy and Momentum	The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.	Students know momentum is separately conserved quantity different from energy.	60	law of conservation of momentum		
PhysHS.02.f Physics	Conservation of Energy and Momentum	The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.	Students know an unbalanced force on an object produces a change in its momentum.	51	balanced and unbalanced forces	16	unbalanced forces and acceleration of car
				60	how to calculate momentum		
				64	calculate momentum		

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PhysHS.03.a Physics	Heat and Thermodynamics	Energy cannot be created or destroyed although in many processes energy is transferred to the environment as heat.	Students know heat flow and work are two forms of energy transfer between systems.	84	work input and output	31	work output vs. work input
				85	some input work is converted to heat	38	explore energy transformations
				91	energy conversions	119	investigate temperature and energy transfer in melting process
				92	where does "spent" energy go?	190	investigate conduction through all states of matter
				96	explain the "lost" energy	192	investigate convection in liquids
				468	heat transfer through air	194	investigate radiation emitted by solids
				468	densely packed solids are good conductors of heat	194	investigate radiation emitted by liquids
				470	convection currents and weather		
				470	warming hands over candle		
				472	convection currents in water		
				476	solid road surface emits radiation		
				478	apply knowledge of heat transfer to different situations		
				481	global warming and heat transfer by radiation		

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PhysHS.03.c Physics	Heat and Thermodynamics	Energy cannot be created or destroyed although in many processes energy is transferred to the environment as heat.	Students know the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy. The greater the temperature of the object energy of motion of the atoms and molecules...	455 temperature and thermal energy and heat 457 specific heat and the heat equation 458 specific heat 459 specific heat of different substances	119 investigate temperature and energy transfer in melting process 182 relationship between heat and temperature

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PhysHS.03.g Physics	Heat and Thermodynamics	Energy cannot be created or destroyed although in many processes energy is transferred to the environment as heat.	Students know how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.	83	how to calculate work	31 calculate work done on block 31 work output vs. work input 185 find efficiency of water heater
				84	work input and output	
				85	efficiency explained	
				85	efficiency and bicycles	
				86	power explained	
				86	how to calculate power	
				96	calculate work done	
				97	calculate work accomplished by a motor	
				97	find the efficiency of a machine	
				97	calculate power	
				97	analyze power of motor	
				97	calculate power of two different machines	
				97	calculate work output from efficiency data	
				97	compare different amounts of work done	
				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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PhysHS.04.a Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know waves carry energy from one place to another.	195 waves transmit energy 474 energy and radiation relationships	
PhysHS.04.b Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know how to identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).	197 transverse and longitudinal waves 205 standing waves on a string	82 study wave pulses on elastic cord 84 make different types of waves in a ripple tank
PhysHS.04.c Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know how to solve problems involving wavelength, frequency, and wave speed.	221 importance of wavelength of sound waves	83 find speed of a wave 86 adjust frequency of a standing wave
PhysHS.04.d Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.	219 frequency of sound and pitch 222 effect of medium on speed of sound wave 222 effect of temperature on speed of sound wave 474 electromagnetic radiation	90 what is sound and how do we hear it? 94 does sound behave like other waves?

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PhysHS.04.e Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×10^8 m/s (186,000 miles/second).	237	visible light and the electromagnetic spectrum	134	investigating visible light with a spectrometer
				237	light waves and the electromagnetic spectrum		
				474	ultraviolet and infrared light		
PhysHS.04.f Physics	Waves	Waves have characteristic properties that do not depend on the type of wave.	Students know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.	201	waves and absorption	85	observing reflection in water waves
				201	waves and refraction	95	interference and sound waves
				201	reflection in water waves and light waves	95	investigate interference with sound waves
				201	waves and reflection	101	examine light through diffraction grating
				202	refraction and eyeglasses	102	polarization of water waves
				206	constructive and destructive interference	102	polarization of a spring wave
				210	can wave interference sink a ship?	103	polarization of light
				223	interference of sound waves	108	explore refraction with a prism
				225	consonance and dissonance and beats		
				240	polarization of light		
				261	refraction and lenses		

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PhysHS.05.a Physics	Electric and Magnetic Phenomena	Electric and magnetic phenomena are related and have many practical applications.	Students know how to predict the voltage or current in simple direct current(DC) electric circuits constructed from batteries, wires, resistors, and capacitors.	101	concept of electric current	44	investigate concept of voltage
				102	concept of electric circuits	45	battery chemicals and electrical charge
				103	circuit diagrams	46	investigate concept of electric current
				113	battery uses chemical energy to produce electrical charge	56	build a parallel circuit
				114	voltage is related to potential energy	56	build a series circuit
				114	voltage and potential energy	57	compare brightness of bulbs in series vs. parallel
				115	how to measure voltage	58	build a series circuit and find total resistance
				145	series circuit defined	60	parallel circuit and Ohm's law
				145	parallel circuit defined	61	compare current and voltage and resistance in each type of circuit
				145	holiday lights as series or parallel		
				145	single path vs. branching paths		
				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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PhysHS.05.b Physics	Electric and Magnetic Phenomena	Electric and magnetic phenomena are related and have many practical applications.	Students know how to solve problems involving Ohm's law.	131 132	Ohm's law explained using Ohm's law to analyze circuits	50	Ohm's law
PhysHS.05.c Physics	Electric and Magnetic Phenomena	Electric and magnetic phenomena are related and have many practical applications.	Students know any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula $Power = IR$.	123 136	understand the concept of electrical resistance potentiometer explained	48	measuring resistance