

Correlation to Ohio Science Academic Content Standards
Foundations of Physical Science with Earth and Space Science
Student Text and Investigation Manual

Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
ES09_01 Earth and Space Science	nine	The Universe	Describe that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium.	611	historical theories of the origin of the moon	255	observe and describe the appearance of the moon and Jupiter and its moons
				612	historical theories about the solar system	264	using spectroscopy to analyze the light emitted by stars and identify most common elements
				621	historical theories of which objects were planets		
				638	the life cycle of stars		
				639	death of small to medium stars results in white dwarfs and planetary nebula and black dwarfs		
				639	description and illustration of the life cycle of stars		
				640	death of massive stars results in supernovas and neutron stars and black holes		
				640	birth of elements		
				640	death of massive stars		
				640	elements formed by nuclear fusion in stars		
				647	the Big Bang theory of the origin of the universe		

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ES09_02 Earth and Space Science	nine	The Universe	Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the Big Bang, over 10 billion years ago.	594	history of the telescope	264	understand why spectroscopy is an important tool of astronomers
				595	types and uses of telescopes		
				596	types and uses of telescopes	268	measuring apparent brightness to calculate the distance to stars and galaxies
				597	satellites as tools of astronomy		
				598	spacecraft as tools of astronomy		
				611	historical theories of the origin of the moon		
				612	historical theories about the solar system		
				621	historical theories of which objects were planets		
				634	the use of spectroscopy to analyze stars		
				647	the Big Bang theory of the origin of the universe		
				648	evidence for the Big Bang theory		
				649	evidence for the Big Bang theory		

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ES09_03 Earth and Space Science	nine	The Universe	Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets and asteroids in the solar system.	591	characteristics of the universe	256	simulate an object in orbit and investigate how orbital period varies within distance
				612	orbits of planets around the sun	258	setting up a scale model of the solar system
				613	explanation and illustration of the solar system	259	determining scale distances for the planets
				614	relative sizes and distances within the solar system	260	determining scale sizes of the planets
				619	asteroids and comets		
				620	meteors and meteorites and the Kuiper Belt		
				633	what is a star?		
				641	the existence of other planetary systems		
				642	what is a galaxy?		
				643	the structure of the Milky Way Galaxy		
				652	research and describe astronomical objects		

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ES09_04 Earth and Space Science	nine	Earth Systems	Explain the relationships of the oceans to the lithosphere and atmosphere (e.g., transfer of energy, ocean currents and landforms).	440	oceans as part of the hydrosphere	207	research how large bodies of water affect climate
				441	the five major oceans	207	research how large bodies of water affect climate
				447	name the five big oceans on Earth	213	exploring how temperature-dependent layering creates currents
				471	description of Earth's atmosphere	215	understanding the Atlantic gyre
				472	effect of life on Earth's atmosphere	223	research a particular biome
				477	layers of the atmosphere	229	using a globe to identify mountain ranges
				478	layers of the atmosphere		
				480	transfer of energy in and out of Earth's atmosphere		
				491	Earth's temperature varies with latitude		
				493	convection currents in the atmosphere		
				494	the Coriolis effect		
				496	descriptions of ocean currents and their effects on climate		
				496	effects of the Gulf Stream on climate of Great Britain		
				497	water in the atmosphere affects weather patterns		
				504	rotation of air masses due to Coriolis effect		

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				510	using maps to identify mountain ranges		
				510	different types of deserts and how they are formed		
				510	effect of cold ocean currents on formation of fog desserts		
				511	how tropical rainforests are formed		
				511	effect of warm ocean currents on formation of tropical rainforest		
				513	effect of large bodies of water on climate		
				515	alpine tundra occurs at high altitudes		
				553	using a map to identify volcanoes		
				564	landforms shaped by water		

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ES09_05 Earth and Space Science	nine	Processes That Shape Earth	Explain how the slow movement of material within Earth results from: thermal energy transfer (conduction and convection) from the deep interior and the action of gravitational forces on regions of different density.	525	formation of Earth's layers	230	predicting plate movement over 50 million years and the resultant land features
				526	description of Earth's layers	236	understanding the Volcanic Explosivity Index
				528	predicting what Earth might look like in 50 million years	237	finding a pattern of volcanoes related to the locations of plate boundaries
				534	land features resulting from divergent plate boundaries	240	estimating the effects of meteor impacts on Earth
				535	resulting land features from subduction	241	identifying which geologic features on Earth were caused by meteors
				536	land features resulting from transform plate boundaries		
				547	predict separation of North America and Europe in 75 million years		
				548	predict effects of divergent plate boundaries on Great Rift Valley		
				551	structure of a volcano		
				552	formation of magma in Earth's mantle		
				554	types and shapes of volcanoes		
				554	figure showing structure of different types of volcanoes		

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				555	formation of shield volcanoes due to hot spots		
				555	shield volcanoes		
				555	formation of Hawaiian Islands due to volcanic activity		
				556	stratovolcanoes		
				556	formation of stratovolcanoes due to subduction		
				558	volcanoes shape the Earth		
				563	constructive process of mountain building		
				563	mountain-building		
				564	the destructive process of erosion		
				564	changes in land features due to erosion		
				565	wind erosion		
				566	effect of glaciers on land		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
ES09_06 Earth and Space Science	nine	Processes That Shape Earth	Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding).	523	faunal succession	229	identifying tectonic plates and plate boundaries
				528	definition of plate tectonics	229	identifying tectonic plates and plate boundaries
				528	predicting what Earth might look like in 50 million years	230	predicting plate movement over 50 million years and the resultant land features
				532	theory of plate tectonics		
				533	describing plate boundaries	236	understanding the Volcanic Explosivity Index
				533	describing plate boundaries	237	examining the magma chemistry of volcanoes and how it relates to a volcano's location
				534	divergent plate boundaries		
				534	divergent plate boundaries	237	finding a pattern of volcanoes related to the locations of plate boundaries
				534	land features resulting from divergent plate boundaries	237	examining the magma chemistry of volcanoes and how it relates to a volcano's location
				535	convergent plate boundaries		
				535	convergent plate boundaries	240	estimating the effects of meteor impacts on Earth
				535	resulting land features from subduction	241	identifying which geologic features on Earth were caused by meteors
				536	transform plate boundaries		
				536	land features resulting from transform plate boundaries	242	understanding how igneous rocks are formed and growing crystals to investigate their formation

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				536	transform plate boundaries	244	understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them
				537	earthquakes and plate tectonics		
				537	causes and descriptions of earthquakes	246	understanding and investigating how metamorphic rocks are formed
				537	earthquakes and plate tectonics		
				537	causes and descriptions of earthquakes	247	interpreting how different rock formations were formed
				539	earthquakes rating scales		
				539	earthquakes rating scales		
				547	predict separation of North America and Europe in 75 million years		
				548	predict effects of divergent plate boundaries on Great Rift Valley		
				551	structure of a volcano		
				552	geologic basis for volcanic eruptions		
				552	formation of magma in Earth's mantle		
				552	geologic basis for volcanic eruptions		
				552	formation of magma in Earth's mantle		

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				553	where volcanic activity occurs		
				553	where volcanic activity occurs		
				554	properties of volcanically formed rock		
				554	figure showing structure of different types of volcanoes		
				554	types and shapes of volcanoes		
				554	properties of volcanically formed rock		
				555	geologic basis for shield volcanoes		
				555	formation of shield volcanoes due to hot spots		
				555	shield volcanoes		
				555	geologic basis for shield volcanoes		
				555	formation of Hawaiian Islands due to volcanic activity		
				556	formation of stratovolcanoes due to subduction		
				556	geologic basis for stratovolcanoes		
				556	stratovolcanoes		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				556	geologic basis for stratovolcanoes		
				557	geologic bases for cinder cone volcanoes		
				557	geologic bases for cinder cone volcanoes		
				558	volcanoes shape the Earth		
				559	types of volcanic rock		
				559	types of volcanic rock		
				561	describing volcanic rock		
				561	describing volcanic rock		
				562	constructive and destructive processes		
				563	mountain-building		
				563	constructive process of mountain building		
				564	the destructive process of erosion		
				564	changes in land features due to erosion		
				565	wind erosion		
				565	formation of soil		
				566	effect of glaciers on land		
				573	formation of igneous and sedimentary and metamorphic rocks		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				575	identifying igneous and sedimentary and metamorphic rocks		
				576	the rock cycle		
ES09_07 Earth and Space Science	nine	Processes That Shape Earth	Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating).	530	sea-floor spreading and mid-ocean ridges	228	listing which kind of plate boundary is associated with each geologic feature
				531	magnetic patterns on the sea floor		

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ES09_08 Earth and Space Science	nine	Historical Perspectives and Scientific Revolutions	Use historical examples to explain how new ideas are limited by the context in which they are conceived: are often initially rejected by the scientific establishment: sometimes spring from unexpected findings: and usually grow slowly ...	34	Aristotle vs. Newton	130	investigate Rutherford's gold foil experiment
				34	Newton and the history of physics		
				45	Newton's Laws of Motion		
				45	Newton's discovery of the 2nd law		
				46	oldest known standard weight		
				54	Newton and the force of gravity		
				105	Benjamin Franklin		
				107	Charles-Augustin Coulomb		
				134	history of superconductivity		
				161	history of magnetism		
				312	history of atomic theory		
				312	contributions of Fermi		
				313	development of atomic theory		
				321	contributions of Mendeleev		
				324	research and create a poster to illustrate development of atomic model		
				343	Avogadro's number		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				363	history of law of conservation of mass		
				393	contributions of Marie and Pierre Curie		
				393	history of nuclear chemistry		
				400	research the Clean Air Act of 1970 and 1990		
				448	research local water supply history		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
INQ09_01 Scientific Inquiry	nine	Doing Scientific Inquiry	Distinguish between observations and inferences given a scientific situation.	372	observe chemical changes	7	variables in an experiment
				435	making observations and asking questions	100	observe glow-in-the-dark paper
				448	forming a hypothesis and testing through experimentation (#5)	146	record detailed observations
				486	observing an aurora	146	observe evidence of chemical change
				602	identify question, hypothesis, procedure, and results (#1)	158	observe temperature changes in chemical reactions
						169	observe Tyndall effect
						172	observe dissolving process
						179	make observations about local surface water
						186	sensing temperature with fingers
						192	observing forced convection through liquids
						192	observe convection currents
						199	collecting Schönbein strips for detecting ozone
						202	collecting data of temperature and sensations
						202	using your hand to sense temperature differences

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						243	recording observations of crystal growing
						251	recording the changes in the moon over a month

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INQ09_02 Scientific Inquiry	nine	Doing Scientific Inquiry	Research and apply appropriate safety precautions when designing and conducting scientific investigations.	452	featured throughout CPO Science program safety caution on heating jar	featured throughout CPO Science program 20 safety tip for car/ramp setup 24 ropes and pulley safety 26 safety tip for hanging weights from lever 40 electrical safety 44 short circuit safety warning 56 short circuit safety warning 58 short circuit safety warning 146 safety in the lab 150 chemistry safety 158 wear goggles and apron 168 safety equipment 172 hot water safety 180 safety tip for water testing 182 safety tips for observing Daphnia 186 thermometer safety 188 heat safety 192 heat safety 202 safety in greenhouse gas investigation	

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						210 safety using light bulbs 216 safety in swinging thermometers 256 safety in lab	

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INQ09_03 Scientific Inquiry	nine	Doing Scientific Inquiry	Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts.	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
				459	heat equation	121	graph mass vs. volume
				485	computer modeling to predict greenhouse effects	147	organize observations into a category table
				494	modeling air currents	151	does your experiment agree with law of conservation of mass?
				518	create a model (#1)	185	constructing a graph of drops of acid vs pH
				524	model of Earth's history	187	construct a graphical model
				533	modeling plate boundaries	187	find equation for trend line
				576	rock cycle model	189	construct a temperature vs. time graph
				614	solar system modeling	197	constructing a graph from atmospheric pressure data
				624	model of the sun's anatomy		
				645	inverse square law		

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						202	modeling the effect of greenhouse gases on Earth's temperature
						203	graphing water and ice temperature readings
						206	constructing a graph of time vs. temperature
						212	modeling underwater rivers and waterfalls and springs
						231	evaluating your completed bathymetric map
						232	construct a model that simulates an earthquake
						247	evaluate your ability to interpret rock formations
						257	inverse square law
						258	setting up a scale model of the solar system
						268	discovering the mathematical relationship between apparent brightness and distance

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INQ09_04 Scientific Inquiry	nine	Doing Scientific Inquiry	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs.	12	importance of reliable and accurate data collection	4	difference between precise and accurate data
				590	astronomic numbers expressed in scientific notation	6	electronic timer and release technique
				592	calculating light year using scientific notation	7	record time interval
				601	converting numbers to scientific notation	9	collect speed data
				606	determining Earth's mass using scientific notation	17	record times
						24	collect weight data
						36	collect precise speed and height data
						75	collect mass and amplitude data
						171	collect time data and record observations
						182	making detailed observations
						184	collecting pH readings while adding carbon dioxide
						186	collecting temperature data
						189	collecting time and temperature data
						193	collecting and recording time and temperature data
						249	using your sundial to collect accurate data
						253	calibrating your telescope

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						271	calculating solar brightness units (SBU) from kilometers in scientific notation

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INQ09_05 Scientific Inquiry	nine	Doing Scientific Inquiry	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology.	20	explain your reasoning		data tables and graphs can be created on computer or graphing calculator
				24	interpretations of patterns in data		
				27	reading a graph	6	compare results with other groups
				27	how to read a graph		
				42	analyze a speed/distance graph	9	present conclusions to the class
				78	analyze lever diagram	9	construct a data table
				476	atmospheric pressure at various altitudes graph	9	reporting on an experiment
				645	apparent brightness vs. distance graph	11	graph speed vs. position
				651	use the diagram to answer the questions (#2)	11	analyze speed change of car
				651	arrange the items in the table (#3)	12	understand and use data table
				651	use the diagram to answer the questions (#4)	15	interpret a speed vs. time graph
						15	discuss and test ideas with your group
						17	record results in data table
						18	organize different combinations of data
						18	study data table for relationship between force and motion
						19	explain how you arrived at your answer

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						24	use data table to record results
						25	analyze block and tackle data
						27	analyze lever equilibrium data
						27	use data table to record results
						29	discuss what you learned about gears
						30	record ropes and pulley data in table
						35	does data support hypothesis?
						36	organize data into a table
						37	describe the flow of energy based on experimental graph
						39	give a brief presentation to the class
						45	did battery voltage change?
						47	present and defend an explanation
						47	discuss an explanation with your group
						75	create data table for self-designed experiment
						76	analyze pendulum data

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						78	reading harmonic motion data tables and graphs
						129	explain your answer and justify
						145	present findings and methods used
						145	present findings to the class
						147	students analyze chemical change lab results
						151	present results to the class
						151	design a data table
						171	use data table for observations
						179	create water quality report
						181	organize water quality data into a table
						181	write paragraph to explain results
						183	write summary of findings
						217	determining relationship between temperature of the atmosphere and relative humidity
						218	interpreting Doppler radar images

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						237	finding a pattern of volcanoes on a bathymetric map
INQ09_06 Scientific Inquiry	nine	Doing Scientific Inquiry	Draw logical conclusions based on scientific knowledge and evidence from investigations.			21 35 45 157 197	construct reasonable explanation based on data study data and determine importance of height on speed of marble analyze data and explain a rule add new rules to list based on findings evaluating your aneroid barometer design

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PS09_01 Physical Science	nine	Nature of Matter	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes.	311	location/size/charge of subatomic particles	132	atomic number determines what element that atom is
				311	protons/neutrons/electrons	133	identify atomic number
				315	atomic number discussed	133	identify mass number
				315	atoms of same element have same atomic number	133	identify element symbol and name
				316	mass number discussed	133	exploring isotopes
				316	isotopes explained	133	protons and neutrons
				322	atomic mass on the periodic table	133	location of electrons in atom
				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	136	understanding isotopes
						137	importance of atomic number
						137	build atomic models
						140	review subatomic particles

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PS09_02 Physical Science	nine	Nature of Matter	Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral.	105 106 107 108 108 318 388	charge is a fundamental property of matter static charge discussed explanation of coulomb how an electroscope works electroscopes proton/electron attraction showing valence electrons in a diagram	42 132 136 140	investigate electric charge building atom models model stable and neutral atoms find the number of electrons in outermost level
PS09_03 Physical Science	nine	Nature of Matter	Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation.	387 388 393 393 400 623	fusion and fission explained nuclear vs chemical reactions radioisotopes in science and medicine carbon dating research pros and cons of nuclear technology nuclear fusion and the sun	138 138 160 160 161	fusion and fission nuclear reactions radioactive decay how do you simulate nuclear decay? research pros and cons of uses for radioactive elements

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PS09_04 Physical Science	nine	Nature of Matter	Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize repeating pattern of electron configurations.	320 321 329 330 332 335 388	groups of elements 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 showing valence electrons in a diagram	133 140 141 142	using the periodic table find the number of electrons in outermost level build model of Na and Cl atoms and explain why they bond to form a molecule arrangement of electrons and groups of elements
PS09_05 Physical Science	nine	Nature of Matter	Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.	324 324 335	which element is more likely to combine with other elements? use the periodic table to predict chemical formulas chemical bonding and the periodic table	136 141 141	ions modeling a chemical bond whan an atom ionizes

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PS09_06 Physical Science	nine	Nature of Matter	Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals, water).	389 389 389	forces in the nucleus strong nuclear force electromagnetic force	136	strong force

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PS09_07 Physical Science	nine	Nature of Matter	Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing chemical formulas and balanced equations)	324	which element is more likely to combine with other elements?	138	nuclear reactions
				324	use the periodic table to predict chemical formulas	141	modeling a chemical bond
				330	ionic bonds	143	classify ionic compounds
				331	covalent bonds	143	name chemical compounds
				332	distinguishing between ionic and covalent bonds	143	predict chemical formulas
				335	chemical bonding and the periodic table	143	ionic compounds
				336	writing a chemical formula	145	determine empirical formula
				338	summary of chemical formula writing rules	148	chemical equations
				339	naming compounds	148	reactants and products
				357	chemical reactions involve rearrangement of atoms	149	practice balancing equations
				359	balancing chemical equations	149	balance these equations
				361	chemical reactions in living systems	152	write the balanced equation
				363	history of law of conservation of mass	152	predict how much product formed given the reactants
				371	which of the equations is balanced?	157	predict the products of double displacement reactions
				378	consumer chemistry	160	how do you simulate nuclear decay?
				378	combustion reactions	162	investigating combustion reactions

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				381	MRE ration heater reaction		
				388	nuclear vs chemical reactions		
				395	chemistry of the atmosphere		
				395	chemistry of the atmosphere		
				397	carbon reactions		
				409	dissolving an ionic compound		
				410	solute dissolution depends on chemical bonds		
				419	dissociation of water		
				438	chemical reactions and the formation of acid rain		

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PS09_08 Physical Science	nine	Nature of Matter	Demonstrate the pH scale (0 - 14) is used to measure acidity and classify solutions as acidic, basic, or neutral.	417	H and OH ions	176	measure pH of everyday solutions
				417	define and compare acids and bases	176	investigate acids and bases
				417	acids and bases compared/contrasted	181	testing pH of tap water samples
				417	properties of acids	184	determining pH of water as carbon dioxide dissolves
				418	strong vs. weak acids		
				418	formulas and reactions of acids and bases		
				418	properties of bases		
				419	strong vs. weak bases		
				419	weak and strong acids and bases		
				420	concentration of hydronium ions determines pH and strength of acids and bases		
				420	defining and determining pH		
				420	pH and pH scale		
				421	table of pH of common substances		
				421	pH of substances you use or consume		
				422	pH and blood		
				422	examples of acid and base chemistry		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				437	concentration of ions and pH		
				437	pH of acid rain		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_09 Physical Science	nine	Nature of Matter	Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors, and semiconductors).	278	pure substances cannot be separated by physical means	114	investigating a mixture
				278	mixtures can be separated by physical means	114	separating a homogeneous mixture
				279	summary of matter classification	114	investigate a homogeneous mixture
				281	volume and mass contrasted	116	mass and volume measurements
				283	atoms and molecules	119	melting point of ice
				284	melting and boiling point explained	124	build a density column
				284	melting and boiling points	126	investigating buoyancy with clay boats
				285	table of melting and boiling points	128	use CPO viscometer to study viscosity
				288	create a poster of matter classification	141	compare and contrast elements and compounds
				291	density is independent of amount of substance	169	investigate solutions and colloids and suspensions
				291	density explained	212	investigate density changes in the oceans as the cause of ocean layering
				292	elasticity is a physical property of matter		
				292	hardness is a physical property of matter		
				293	brittleness is a physical property of matter		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				294	tensile strength is a physical property of matter		
				294	malleability is a physical property of matter		
				295	relationship between mass volume and density		
				296	density of liquid water vs. ice		
				297	buoyancy explained		
				298	sinking and floating		
				302	viscosity of motor oils		
				305	viscosity of glue mixtures		
				407	solutions are mixtures		
				408	colloids and suspensions		
				426	mixtures and emulsifying agents		
PS09_10 Physical Science	nine	Nature of Matter	Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity.	121	electrical conductivity explained	49	conductivity of aluminum vs. copper
				461	thermal conductivity explained		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_11 Physical Science	nine	Nature of Energy	Explain how thermal energy exists in the random motion and vibrations of atoms and molecules (kinetic energy). Recognize that the higher the temperature, the greater the molecular motion, and during changes of state the temp. remains constant.	451	temperature is a measure of average kinetic energy	119	investigate temperature and energy transfer in melting process
				451	increasing temperature means increasing motion of molecules	119	investigate melting and create a graph
				452	molecular motion increases when temperature increases	119	adding heat energy to melt an ice cube
				454	changes in temperature are directly related to changes in energy	119	create a temperature vs. time graph of phase change
				454	temperature and thermal energy and heat	188	investigate heating water with an immersion heater
				455	examples of flow of heat	188	relationship between heat and temperature
				461	conduction and convection and radiation	188	investigate the increase of temperature of water as thermal energy is added
				462	densely packed solids are good conductors of heat	192	investigate convection in liquids
				462	heat transfer through air	203	investigate the temperature/time curves as water is cooled through a phase change to ice
				463	convection currents and weather		
				463	warming hands over candle		
				464	convection currents in water	204	compare the shape of the water line and the ice line on the temperature/time graph
				465	solid road surface emits radiation		
				465	transfer of heat by radiation		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				482	global warming and heat transfer by radiation		
				493	apply knowledge of heat transfer to different situations		
PS09_12 Physical Science	nine	Nature of Energy	Explain how an object's kinetic energy depends on its mass and its speed.	87	concept of energy as stored work	36	energy conservation and the roller coaster
				91	following an energy transformation	38	identify potential/kinetic energy conversions
				537	potential energy transformed to kinetic energy causes earthquakes		
PS09_13 Physical Science	nine	Nature of Energy	Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight and height above a reference surface.	91	following an energy transformation	36	energy conservation and the roller coaster
				537	potential energy transformed to kinetic energy causes earthquakes	38	identify potential/kinetic energy conversions

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_14 Physical Science	nine	Nature of Energy	Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at high energies).	387 623	fusion and fission explained nuclear fusion and the sun	138	fusion and fission

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_15 Physical Science	nine	Nature of Energy	Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.	88 90 91 91 91 92 93 96 623 626	potential and kinetic energy explained conservation of energy explained following an energy transformation understand basic forms of energy energy conversions energy transformations and conservation different forms of energy described prove that energy is conserved energy from the sun harnessing the sun's energy	37 38 38 39 39	investigating conservation of energy with rollercoaster explore energy transformations conservation of energy and energy transformations make an energy flow chart identify type of energy involved
PS09_16 Physical Science	nine	Nature of Energy	Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels).	381 382	exothermic reactions and MREs endothermic reactions and cold packs	158 158	investigate energy changes in chemical reactions measure energy changes in 3 different reactions

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_17 Physical Science	nine	Nature of Energy	Demonstrate that thermal energy can be transferred by conduction, convection or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation).	462 462 463 463 464 465 465 482 493	densely packed solids are good conductors of heat heat transfer through air convection currents and weather warming hands over candle convection currents in water transfer of heat by radiation solid road surface emits radiation global warming and heat transfer by radiation apply knowledge of heat transfer to different situations	192	investigate convection in liquids

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_18 Physical Science	nine	Nature of Energy	Demonstrate that electromagnetic radiation is a form of energy. Recognize that spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays).	196 237 237 237 237 250 272 479	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

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_19 Physical Science	nine	Nature of Energy	Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium.	196 197 205 237 237 250 272 480 538	waves are all around us transverse and longitudinal waves standing waves on a string microwave ovens radio and television signals identify uses of electromagnetic waves identify uses of electromagnetic waves electromagnetic radiation body waves	82 84	study wave pulses on elastic cord make different types of waves in a ripple tank

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_20 Physical Science	nine	Nature of Energy	Describe how waves can superimpose on one another when propoagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed, and change direction and speed when entering a different material.	201	waves and absorption	85	observing reflection in water waves
				201	waves and reflection	95	interference and sound waves
				201	reflection in water waves and light waves	95	investigate interference with sound waves
				201	waves and refraction	101	examine light through diffraction grating
				202	refraction and eyeglasses	106	tracing incident and reflected rays
				206	constructive and destructive interference	106	investigate reflection of light
				210	can wave interference sink a ship?	107	investigate how light interacts with mirrors
				223	interference of sound waves	107	plot reflected rays from a mirror
				225	consonance and dissonance and beats	108	tracing incident and refracted rays
				258	forming images with lenses	108	explore refraction with lenses
				258	refraction in optical systems	108	investigate how light interacts with a prism
				260	reflection and mirrors	108	explore refraction with a prism
				261	refraction and lenses	110	finding focal point and focal length of a lens
				263	index of refraction	111	plotting images formed when light is refracted by a lens
				263	index of refraction		
				273	find the angle of reflection		
				480	absorption and emission		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
						253	using a retractive telescope

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_21 Physical Science	nine	Forces and Motion	Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time.	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	model the car's motion graphically
				24	accurate speed measurements	12	find speed of car at different positions
				29	position vs. time graph discussion	12	calculate speed of moving car
				30	position vs. time graphs	13	make a position vs. time graph
				32	average speed vs. instantaneous	14	calculate speed of car at two places on the ramp
				32	average speed discussed	14	acceleration is the rate at which speed changes
				33	understanding acceleration	14	calculate acceleration of car on ramp
				35	how to calculate acceleration	15	make a speed vs. time graph
				36	examples of acceleration	15	make a speed vs. time graph
				37	speed vs. time graphs	15	changes in motion can be represented graphically
				37	speed vs. time graph discussion	17	explore 2nd law and acceleration
				41	find acceleration of car	17	caclulate speed of car
				42	calculate speed from distance/time graph	36	find speed of marble
				49	link between force and acceleration		
53	acceleration due to gravity						

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_22 Physical Science	nine	Forces and Motion	Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced force acts on it.	45 46 48 49 51 51	Newton's first law summarized force has potential to change motion Newton's first law in detail force is related to acceleration net force explained balanced and unbalanced forces	14 16 19	exploring acceleration on a ramp unbalanced forces and acceleration of car find correct relationship between force mass and acceleration
PS09_23 Physical Science	nine	Forces and Motion	Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object.	45 48 49 50 64 599	Newton's second law summarized Newton's laws explained and applied Newton's second law in detail Newton's second law applied solving problems using $f=ma$ Newton's first law of motion and the space shuttle	16 16 19 20	2nd law thinking about force discover 2nd law of motion force and motion with car and ramp
PS09_24 Physical Science	nine	Forces and Motion	Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.	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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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_25 Physical Science	nine	Forces and Motion	Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight).	56 64	friction explained research effect of friction on human joints	21	effect of friction on the car

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_26 Physical Science	nine	Historical Perspectives and Scientific Revolutions	Use historical examples to explain how new ideas are limited by the context in which they are conceived; ar often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly ...	34	Newton and the history of physics	130	investigate Rutherford's gold foil experiment
				45	Newton's discovery of the 2nd law	198	contributions of Schönbein
				45	Newton's Principia		
				46	oldest known standard weight		
				55	Newton and the apple legend		
				73	Leonardo DaVinci		
				86	James Watt		
				110	research Franklin's electricity experiments		
				115	Volta's batteries		
				131	Georg Ohm's work with circuits		
				134	history of superconductivity		
				160	Faraday's contributions		
				161	history of magnetism		
				312	history of atomic theory		
				312	Dalton's contributions		
				313	development of atomic theory		
				320	the quests of alchemists		
321	Mendeleev's periodic table						

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				324	research and create a poster to illustrate development of atomic model		
				332	Linus Pauling and electronegativities		
				343	Avogadro's number		
				363	history of law of conservation of mass		
				363	Antoine Lavoisier		
				370	research Lavoisier's contributions		
				391	scientific discovery and the atomic age		
				393	Marie and Pierre Curie		
				393	accomplishments of Marie Curie		
				393	history of nuclear chemistry		
				400	research the Clean Air Act of 1970 and 1990		
				448	research local water supply history		
				455	contributions of Joule		
				457	Joseph Black		
				468	research the history of heat and temperature		
				583	history of calendars		

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				585	counting the days in a year		
				586	the history of clocks and the division of time		
				589	ancient beliefs about solar eclipses		
				594	history of the telescope		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS09_27 Physical Science	nine	Historical Perspectives and Scientific Revolutions	Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics and ceramics and communication tech.)	34	Aristotle vs. Newton	130	investigate Rutherford's gold foil experiment
				45	Newton's Laws of Motion	163	economic impact of end-product of combustion reaction
				54	Newton and the force of gravity	163	too much CO ₂
				105	Benjamin Franklin	163	consider a vehicle's fuel economy
				107	Charles-Augustin Coulomb	163	research how trees offset accumulation of CO ₂
				313	development of atomic theory	163	research how trees offset accumulation of CO ₂
				321	contributions of Mendeleev	163	can trees compensate for manmade CO ₂ from vehicles and industry?
				321	contributions of Mendeleev	164	perform water quality tests
				324	research and create a poster to illustrate development of atomic model	178	wise use of water supply
				333	problems with disposing of plastics	179	maintaining water supply quality
				355	recycling tires	180	save water for houseplants
				356	recycling discarded tires	180	perform water quality tests
				364	petroleum	182	investigate effect of acid rain on microorganisms
				368	limiting reactants	201	research the causes of ozone in the lower atmosphere
				379	research environmental impact of fuel cells		
				379	research fuel cells		
				379	hydrogen-powered cars and the environment		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				379	research economic impact of fuel cells		
				379	research fuel cells		
				392	storage of nuclear waste		
				395	fossil fuels		
				400	economic impact of pollution		
				400	problems caused by airborne pollutants		
				400	economic impact of reducing air pollution		
				432	water cycle and conservation		
				433	wise use of water		
				435	water usage and quality		
				436	effect of excess nitrates on environment		
				437	acid rain explained		
				448	research the issue of acid rain		
				448	research economic impact of producing gases that cause acid rain		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
ST09_01 Science and Technology	nine	Understanding Technology	Describe means of comparing the benefits with the risks of technology and how science can inform public policy.	379	research fuel cells	163	too much CO ₂
				379	research environmental impact of fuel cells	163	research how trees offset accumulation of CO ₂
				379	hydrogen-powered cars and the environment	163	research how trees offset accumulation of CO ₂
				395	fossil fuels		
				400	clean air act of 1970	163	can trees compensate for manmade CO ₂ from vehicles and industry?
				400	problems caused by airborne pollutants		
				414	effect of electrical generating facilities on dissolved oxygen in water	164	perform water quality tests
				429	governments managing water resources	178	wise use of water supply
				433	wise use of water	180	perform water quality tests
				435	water usage and quality	201	research the causes of ozone in the lower atmosphere
				436	effect of excess nitrates on environment		
				448	is acid rain a problem in your community?		
				448	how is the government addressing the problem of acid rain?		
				448	what is the history of your community's water supply and treatment		
				479	London Agreement of 1991		

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				483	should governments enforce changes for lowering greenhouse gas levels		
ST09_02 Science and Technology	nine	Abilities To Do Technological Design	Identify a problem or need, propose designs and choose among alternative solutions for the problem.	74	sample engineering problem	70 70 71 71 194	designing and testing different electric motors proposing and comparing different electric motor designs which motor gave the highest speed and why? did draining the batteries affect motor speed? design and construct an aneroid barometer
ST09_03 Science and Technology	nine	Abilities To Do Technological Design	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined.	74	sample engineering problem	70 70 71 71 71 194	designing and testing different electric motors proposing and comparing different electric motor designs testing a motor for performance which motor gave the highest speed and why? did draining the batteries affect motor speed? design and construct an aneroid barometer