

**Correlation to Michigan Content Expectations: Essential - High School Science
Foundations of Physical Science with Earth and Space Science (Second Edition)
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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
C1.01A Chemistry	Inquiry, Reflection, and Social Implications	Scientific Inquiry	Generate new questions that can be investigated in the laboratory or field.	7	experimentation begins with a question	6	how do we ask questions and get answers from nature?
				10	the research question and hypothesis	7	variables in an experiment
				19	design your own experiment	7	design your own experiment
				42	devise an experiment	7	perform your own experiment
				435	why haven't we run out of water	9	design three experiments using car and ramp
				440	what is in your tap water	10	conduct car/ramp experiment
				443	what is acid rain	16	investigate Newton's 2nd law
				447	why are oceans salty	16	decide how to vary the force on the car for this experiment
				454	forming a hypothesis and testing through experimentation (#5)	26	what variables can be changed?
				462	asking questions pertaining to specific heat and heat flow	34	investigate motion on a rollercoaster
				478	why is Earth's atmosphere different from other planets	75	design pendulum experiment
				479	why do ears pop	75	perform self-designed experiment
				498	why does Earth have seasons	93	decision trees and the advantage of doing multiple trials
				507	how does rain form		
				515	how do animals survive in the desert		
				521	what is a carbon sink		

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				540	why doesn't Earth get bigger and bigger	151	design experiment to find out if mass is conserved
				594	what causes eclipses	170	what three factors influence dissolving rate?
				608	identify question, hypothesis, procedure, and results (#1)	182	simulating the effect of acid rain on daphnia
				627	is Pluto a planet	188	conducting investigation of efficiency of immersion heater
						193	conducting experiments on heat transfer
						205	investigating how specific heat of water regulates Earth's temperature
						233	identifying how the earthquake model represents an earthquake

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C1.01B Chemistry	Inquiry, Reflection, and Social Implications	Scientific Inquiry	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables...	11	control and experimental variables	7	doing a controlled experiment
				11	controlling variables in experiments	7	what variables should be controlled?
				19	which group did the best experiment?	11	calculate % error
				19	did you run a controlled experiment?	18	evaluate graphs as to whether or not they show relationships between variables
				20	what factors could explain the variability in their data?	21	think about percent change
				26	independent and dependent variables	21	evaluate percent change for data collected
				491	what percentage comes from this source? (problem 4)	21	choose independent and dependent variables for graph
				549	determining distance to an epicenter	27	recognize variables
				553	what explains the difference in density? (#5)	75	evaluate statistical significance
				611	how big is Earth?	76	calculate % error
						129	control the height of the liquid
						169	why was plain water tested?
						169	what does the word control mean?
		171	evaluate method based on data				

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					190 effect of changing mass on collected data 197 calculating error between your barometer and a commercial barometer 199 importance of good record keeping in order to avoid error 200 evaluating your qualitative ozone strips 211 determining whether distance from light source or axial tilt plays a more significant role in causing the seasons

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C1.01C Chemistry	Inquiry, Reflection, and Social Implications	Scientific Inquiry	Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).	3	time measurement	4	difference between precise and accurate data
				5	make measurements with precision	5	making measurements with precision
				6	scientists use metric units	6	electronic timer and release technique
				12	importance of reliable and accurate data collection	7	measure and record variables
				80	use and understand mass measurements	7	record time interval
				286	measuring volume of solids	7	use a ruler to make a measurement
				286	measuring volume of liquids	9	design three experiments and choose equipment
				294	find the thickness of a single card	9	conduct three experiments with appropriate equipment
				591	understanding time measurement in years	9	design three experiments and choose equipment
				592	clocks and the division of time	9	collect speed data
						10	selecting ramp and photogates
						12	select equipment and set up experiment
						12	make metric length measurement
		17	measure the force				
		17	record times				
		17	measure the force				

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
					24 collect weight data
					25 measure and record the force
					30 measure height difference
					30 rigging block and tackle
					36 make precise height measurements
					36 collect precise speed and height data
					44 using electrical meter
					46 using electrical meter
					48 using electrical meter
					50 using electrical meter
					63 making measurements with precision
					75 collect mass and amplitude data
					75 make precise length measurements
					116 measuring mass
					117 measuring volume
					145 plan a procedure and select necessary equipment
					145 carry out procedure and select equipment
					151 select materials from list

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
					151 plan procedures and select materials
					158 use a thermometer
					171 collect time data and record observations
					176 measure pH
					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
					194 design and construct an aneroid barometer
					209 measuring the intensity of light using an electric meter and solar cell and light bulb
					249 using your sundial to collect accurate data
					249 calibrating a sundial

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
					252 identifying the parts of a refracting telescope and making observations of the moon's surface 253 calibrating your telescope

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page		
C1.01D Chemistry	Inquiry, Reflection, and Social Implications	Scientific Inquiry	Identify patterns in data and relate them to theoretical models.	24	interpretations of patterns in data	6	compare results with other groups
				24	making a graph	11	analyze speed change of car
				26	creating graphs	11	graph speed vs. position
				27	reading a graph	13	graph distance vs. time
				41	make a graph	15	construct a quantitative graphical model
				42	interpreting distance/time graph	15	interpret a speed vs. time graph
				42	analyze a speed/distance graph	18	study data table for relationship between force and motion
				80	analyze lever diagram	25	analyze block and tackle data
				465	heat equation	25	create a mathematical model
				482	atmospheric pressure at various altitudes graph	27	find math rule for lever equilibrium
				553	average density (#5)	27	analyze lever equilibrium data
				624	average distance from the sun	28	derive a math formula
				651	apparent brightness vs. distance graph	35	does data support hypothesis?
				651	inverse square law	37	organize data into a graph of speed vs. height
				657	use the diagram to answer the questions (#4)	45	did battery voltage change?
				657	use the diagram to answer the questions (#2)		
657	arrange the items in the table (#3)						

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					51 graph voltage vs. current
					76 analyze pendulum data
					121 graph mass vs. volume
					129 find average velocity
					147 organize observations into a category table
					147 students analyze chemical change lab results
					171 average dissolving rate
					185 constructing a graph of drops of acid vs pH
					187 find equation for trend line
					187 construct a graphical model
					189 construct a temperature vs. time graph
					197 constructing a graph from atmospheric pressure data
					203 graphing water and ice temperature readings
					206 constructing a graph of time vs. temperature
					217 determining relationship between temperature of the atmosphere and relative humidity

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
					218 interpreting Doppler radar images 237 finding a pattern of volcanoes on a bathymetric map 257 inverse square law 268 discovering the mathematical relationship between apparent brightness and distance 275 calculating bicycle gear ratios

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C1.01E Chemistry	Inquiry, Reflection, and Social Implications	Scientific Inquiry	Describe a reason for a given conclusion using evidence from an investigation.	19 which group did the best experiment?	18 evaluate graphs as to whether or not they show relationships between variables 21 evaluate percent change for data collected 21 construct reasonable explanation based on data 35 study data and determine importance of height on speed of marble 45 analyze data and explain a rule 75 evaluate statistical significance 157 add new rules to list based on findings 171 evaluate method based on data 197 evaluating your aneroid barometer design 200 evaluating your qualitative ozone strips

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
C1.02A Chemistry	Inquiry, Reflection, and Social Implications	Scientific Reflection and Social Implications	Critique whether or not specific questions can be answered through scientific investigations.	7	experimentation begins with a question	6	predict which car will move fastest
				10	the research question and hypothesis	6	how do we ask questions and get answers from nature?
				19	design your own experiment	7	variables in an experiment
				20	finding variability in data	7	test the effect of one other variable
				42	devise an experiment	7	design your own experiment
				81	look at force data and decide the usefulness of a machine	9	design three experiments using car and ramp
				435	why haven't we run out of water	9	devise a hypothesis
				440	what is in your tap water	16	decide how to vary the force on the car for this experiment
				443	what is acid rain		
				447	why are oceans salty	18	use data to describe relationship between force and motion
				454	forming a hypothesis and testing through experimentation (#5)	19	use data to infer correct relationship between variables
				462	asking questions pertaining to specific heat and heat flow	26	what variables can be changed?
				478	why is Earth's atmosphere different from other planets	27	think about the variables
				479	why do ears pop	30	interpret block and tackle data
				498	why does Earth have seasons	34	where does the marble move the fastest?

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				507	how does rain form	43	how did A and B tapes acquire different charge?
				515	how do animals survive in the desert	75	investigate variables that affect the period of a pendulum
				521	what is a carbon sink		
				540	why doesn't Earth get bigger and bigger	75	design pendulum experiment
				594	what causes eclipses	93	decision trees and the advantage of doing multiple trials
				608	identify question, hypothesis, procedure, and results (#1)	141	build models of Na and Cl and use them to explain bonding
				627	is Pluto a planet	151	perform the experiment you designed
						151	explain how hypothesis compares to results
						151	design experiment to find out if mass is conserved
						170	devise hypothesis and explain
						170	what three factors influence dissolving rate?
						182	making hypotheses and testing them against observations
						185	analyzing the results of the buffered acid experiment

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
					193 explaining efficiency of heat transfer based on data 208 testing hypothesis of why seasons occur against your observations in the investigation 224 reconstruct a series of events from clues 233 identifying how the earthquake model represents an earthquake 235 interpreting how the drumming affects the intensity of the earthquake in the model

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C1.02B Chemistry	Inquiry, Reflection, and Social Implications	Scientific Reflection and Social Implications	Identify and critique arguments about personal or societal issues based on scientific evidence.	220 ultrasound technology 226 voice recognition technology 300 invention of Kevlar 406 clean air act of 1970 435 governments managing water resources 454 is acid rain a problem in your community? 454 what is the history of your community's water supply and treatment 454 how is the government addressing the problem of acid rain? 485 London Agreement of 1991 489 should governments enforce changes for lowering greenhouse gas levels	163 evaluating choice of favorite car

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C1.02C Chemistry	Inquiry, Reflection, and Social Implications	Scientific Reflection and Social Implications	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	75 impact of Da Vinci's work 116 research Franklin's electricity experiments 319 development of atomic theory 330 research and create a poster to illustrate development of atomic model 406 research the Clean Air Act of 1970 and 1990 454 research local water supply history 474 research the history of heat and temperature	130 investigate Rutherford's gold foil experiment

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C1.02D Chemistry	Inquiry, Reflection, and Social Implications	Scientific Reflection and Social Implications	Evaluate scientific explanations in a peer review process or discussion format.	20 explain your reasoning	9 present conclusions to the class 15 discuss and test ideas with your group 19 explain how you arrived at your answer 29 discuss what you learned about gears 37 describe the flow of energy based on experimental graph 39 give a brief presentation to the class 47 discuss an explanation with your group 47 present and defend an explanation 129 explain your answer and justify 145 present findings and methods used 151 present results to the class 276 create a report with a diagram, data table, and conclusion

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C1.02E Chemistry	Inquiry, Reflection, and Social Implications	Scientific Reflection and Social Implications	Evaluate the future career and occupational prospects of science fields.	458	civil engineers and bridge design	177	chemistry and photography
				463	engineers design better products when they know specific heat	178	water quality testing
				548	seismologists	178	water quality specialist
				567	volcanologists	222	zoo exhibit designers
C2.02A Chemistry	Forms of Energy	Molecules in Motion	Describe conduction in terms of molecules bumping into each other to transfer energy. Explain why there is better conduction in solids and liquids than gases.	468	heat transfer through air	192	investigate convection in liquids
				468	densely packed solids are good conductors of heat		
				469	convection currents and weather		
				469	warming hands over candle		
				470	convection currents in water		
				471	solid road surface emits radiation		
				471	transfer of heat by radiation		
				488	global warming and heat transfer by radiation		
				499	apply knowledge of heat transfer to different situations		

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C2.02B Chemistry	Forms of Energy	Molecules in Motion	Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.	291	characteristics of matter related to its state	118	observe melting process and study quantitatively 118 think of melting process at molecular level
C3.03A Chemistry	Energy Transfer and Conservation	Heating Impacts	Describe how heat is conducted in a solid.	467	thermal conductivity explained		
C3.03B Chemistry	Energy Transfer and Conservation	Heating Impacts	Describe melting on a molecular level.	290	changes of state	119	adding heat energy to melt an ice cube
				457	increasing temperature means increasing motion of molecules	119	energy and phase changes
				458	molecular motion increases when temperature increases		
				504	phases changes in the atmosphere		
C3.04A Chemistry	Energy Transfer and Conservation	Endothermic and Exothermic Reactions	Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory.	387	exothermic reactions and MREs	158	investigate energy changes in chemical reactions
				388	endothermic reactions and cold packs	158	measure energy changes in 3 different reactions
C3.04B Chemistry	Energy Transfer and Conservation	Endothermic and Exothermic Reactions	Explain why chemical reactions will either release or absorb energy.	461	examples of flow of heat	158	measure energy changes in 3 different reactions
				467	conduction and convection and radiation	188	investigate heating water with an immersion heater
C4.02A Chemistry	Properties of Matter	Nomenclature	Name simple binary compounds using their formulae.	345	naming compounds	143	name chemical compounds

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C4.02B Chemistry	Properties of Matter	Nomenclature	Given the name, write the formula of simple binary compounds.	342 344	writing a chemical formula summary of chemical formula writing rules	143 145	predict chemical formulas determine empirical formula
C4.03A Chemistry	Properties of Matter	Properties of Substances	Recognize that substances that are solid at room temperature have stronger attractive forces than liquids at room temperature, which have stronger attractive forces than gases at room temperature.	290 411	states of matter and arrangement of molecules molecular structure of ice	118 118	molecules in a liquid investigate melting
C4.03B Chemistry	Properties of Matter	Properties of Substances	Recognize that solids have a more ordered, regular arrangement of their particles than liquids and that liquids are more ordered than gases.	290 411	states of matter and arrangement of molecules molecular structure of ice	118 118	molecules in a liquid investigate melting
C4.08A Chemistry	Properties of Matter	Atomic Structure	Identify the location, relative mass, and charge for electrons, protons, and neutrons.	317 317 324	location/size/charge of subatomic particles protons/neutrons/electrons proton/electron attraction	132 133 133 136 137 140	building atom models location of electrons in atom protons and neutrons model stable and neutral atoms build atomic models review subatomic particles

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C4.08B Chemistry	Properties of Matter	Atomic Structure	Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus.	394 showing valence electrons in a diagram	140 find the number of electrons in outermost level
C4.08C Chemistry	Properties of Matter	Atomic Structure	Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.	395 forces in the nucleus 395 strong nuclear force 395 electromagnetic force	136 strong force
C4.08D Chemistry	Properties of Matter	Atomic Structure	Give the number of electrons and protons present if the fluoride ion has a -1 charge.	321 atomic number discussed 322 isotopes explained 322 mass number discussed 328 atomic number on the periodic table 328 chemical symbols and element names 328 atomic mass on the periodic table 328 mass number on the periodic table	133 exploring isotopes 133 identify mass number 133 identify element symbol and name 133 identify atomic number 136 understanding isotopes 136 atomic number 136 mass number 136 ions 141 when an atom ionizes

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C4.09A Chemistry	Properties of Matter	Periodic Table	Identify elements with similar chemical and physical properties using the periodic table.	326	groups of elements	133	using the periodic table
				327	groups of elements and valence shells	141	build model of Na and Cl atoms and explain why they bond to form a molecule
				335	periodic table columns and valence electrons	142	arrangement of electrons and groups of elements
				336	bonding and periodic table position		
				338	periodic table and electronegativities		
				341	periodic table and oxidation numbers		
C4.10A Chemistry	Properties of Matter	Neutral Atoms, Ions, and Isotopes	List the number of protons, neutrons, and electrons for any given ion or isotope.	321	atomic number discussed	133	exploring isotopes
				322	isotopes explained	133	identify mass number
				322	mass number discussed	133	identify element symbol and name
				328	atomic number on the periodic table	133	identify atomic number
				328	chemical symbols and element names	136	understanding isotopes
				328	atomic mass on the periodic table	136	atomic number
				328	mass number on the periodic table	136	mass number
C5.02A Chemistry	Changes in Matter	Chemical Changes	Balance simple chemical equations applying the conservation of matter.	377	which of the equations is balanced?	149	balance these equations

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C5.02B Chemistry	Changes in Matter	Chemical Changes	Distinguish between chemical and physical changes in terms of the properties of the reactants and products.	359	physical and chemical changes and digestion	146	investigate and observe chemical and physical changes in the lab
				361	physical and chemical changes in tire recycling	148	reactants and products
				365	balancing chemical equations	149	practice balancing equations
				378	determine if changes are chemical or physical	152	write the balanced equation
						152	predict how much product formed given the reactants
C5.02C Chemistry	Changes in Matter	Chemical Changes	Draw pictures to distinguish the relationships between atoms in physical and chemical changes.	290	states of matter and arrangement of molecules	118	molecules in a liquid
				363	chemical reactions involve rearrangement of atoms	118	investigate melting
				411	molecular structure of ice	119	adding heat energy to melt an ice cube
				457	increasing temperature means increasing motion of molecules	157	predict the products of double displacement reactions
				458	molecular motion increases when temperature increases		

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C5.04A Chemistry	Changes in Matter	Phase Change/Diagrams	Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.	460 changes in temperature are directly related to changes in energy 461 definition of calorie 462 definition of specific heat 462 specific heat 464 water's specific heat helps regulate Earth's temperature 465 heat equation	119 investigate temperature and energy transfer in melting process 188 investigate the increase of temperature of water as thermal energy is added 190 calculating thermal energy in calories 205 investigating how the high specific heat of water helps regulate Earth's temperature
C5.04B Chemistry	Changes in Matter	Phase Change/Diagrams	Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.		119 investigate melting and create a graph 119 create a temperature vs. time graph of phase change 203 investigate the temperature/time curves as water is cooled through a phase change to ice 204 compare the shape of the water line and the ice line on the temperature/time graph

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C5.05A Chemistry	Changes in Matter	Chemical Bonds — Trends	Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.	330	which element is more likely to combine with other elements?	141	modeling a chemical bond
				330	use the periodic table to predict chemical formulas	143	ionic compounds
				336	Lewis dot diagrams		
				341	chemical bonding and the periodic table		
C5.05B Chemistry	Changes in Matter	Chemical Bonds — Trends	Predict the formula for binary compounds of main group elements.	342	writing a chemical formula	143	predict chemical formulas
				344	summary of chemical formula writing rules	145	determine empirical formula
C5.07A Chemistry	Changes in Matter	Acids and Bases	Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.	423	properties of acids	176	investigate acids and bases
				423	H and OH ions		
				423	acids and bases compared/contrasted		
				423	define and compare acids and bases		
				424	properties of bases		
				424	strong vs. weak acids		
				425	weak and strong acids and bases		
				425	strong vs. weak bases		

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C5.07B Chemistry	Changes in Matter	Acids and Bases	Predict products of an acid-base neutralization.	423	acids and bases compared/contrasted	176	measure pH of everyday solutions
				423	define and compare acids and bases	176	investigate acids and bases
				423	properties of acids		
				423	H and OH ions		
				424	formulas and reactions of acids and bases		
				424	properties of bases		
				426	concentration of hydronium ions determines pH and strength of acids and bases		
				428	examples of acid and base chemistry		
				428	pH and blood		
				443	pH of acid rain		
443	concentration of ions and pH						

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C5.07C Chemistry	Changes in Matter	Acids and Bases	Describe tests that can be used to distinguish an acid from a base.	423	acids and bases compared/contrasted	176	measure pH of everyday solutions
				423	define and compare acids and bases	176	investigate acids and bases
				424	formulas and reactions of acids and bases	181	testing pH of tap water samples
				426	concentration of hydronium ions determines pH and strength of acids and bases	184	determining pH of water as carbon dioxide dissolves
				426	pH and pH scale		
				426	defining and determining pH		
				427	pH of substances you use or consume		
				427	table of pH of common substances		
				428	examples of acid and base chemistry		
				428	pH and blood		
				443	pH of acid rain		
				443	concentration of ions and pH		

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C5.07D Chemistry	Changes in Matter	Acids and Bases	Classify various solutions as acidic or basic, given their pH.	424	formulas and reactions of acids and bases	176	measure pH of everyday solutions
				426	concentration of hydronium ions determines pH and strength of acids and bases	181	testing pH of tap water samples
				426	pH and pH scale	184	determining pH of water as carbon dioxide dissolves
				426	defining and determining pH		
				427	pH of substances you use or consume		
				427	table of pH of common substances		
				428	examples of acid and base chemistry		
				428	pH and blood		
				443	pH of acid rain		
				443	concentration of ions and pH		
C5.07E Chemistry	Changes in Matter	Acids and Bases	Explain why lakes with limestone or calcium carbonate experience less adverse effects from acid rain than lakes with granite beds.	443	acid rain explained	182	investigate effect of acid rain on microorganisms
				454	research the issue of acid rain		

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C5.08A Chemistry	Changes in Matter	Carbon Chemistry	Draw structural formulas for up to ten carbon chains of simple hydrocarbons.	370	carbon chains	162	carbon reactions and the environment
				400	photosynthesis and carbon reactions	162	importance of fossil fuels
				401	fossil fuels and carbon reactions	162	structure of fossil fuels
C5.08B Chemistry	Changes in Matter	Carbon Chemistry	Draw isomers for simple hydrocarbons.	370	carbon chains	162	carbon reactions and the environment
				400	photosynthesis and carbon reactions	162	importance of fossil fuels
				401	fossil fuels and carbon reactions	162	structure of fossil fuels
C5.08C Chemistry	Changes in Matter	Carbon Chemistry	Recognize that proteins, starches, and other large biological molecules are polymers.	400	photosynthesis and carbon reactions	162	importance of fossil fuels
				401	fossil fuels and carbon reactions	162	structure of fossil fuels

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
E2.1A Earth Science	Earth Systems	Earth Systems Overview	Explain why the Earth is essentially a closed system in terms of matter.	435 the water cycle 445 illustration of acid rain formation 446 oceans in the water cycle 446 oceans as part of the hydrosphere 477 description of Earth's atmosphere 478 effect of life on Earth's atmosphere 483 ozone in the stratosphere 483 layers of the atmosphere 484 layers of the atmosphere 485 ozone depletion 488 changes to the oceans due to increasing global temperatures 491 computer modeling to predict greenhouse effects 565 volcanoes and water vapor 574 how urban sprawl changes local climate	178 investigating the water cycle

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
E2.1B Earth Science	Earth Systems	Earth Systems Overview	Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.	446	oceans as part of the hydrosphere		
				477	description of Earth's atmosphere		
				478	effect of life on Earth's atmosphere		
				483	ozone in the stratosphere		
				483	layers of the atmosphere		
				484	layers of the atmosphere		
				485	ozone depletion		
E2.1C Earth Science	Earth Systems	Earth Systems Overview	Explain, using specific examples, how a change in one system affects other Earth systems.	443	effects of acid rain on natural environments	178	actions to take to improve water quality
				477	nitrogen cycle	207	research how large bodies of water affect climate
				499	convection currents in the atmosphere	213	exploring how temperature-dependent layering creates currents
				502	descriptions of ocean currents and their effects on climate	215	understanding the Atlantic gyre
				514	causes and effects of the El Nino Southern Oscillation		
E2.2A Earth Science	Earth Systems	Energy in Earth Systems	Describe the Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy).	486	distribution of incoming solar radiation	160	radioactive decay
				487	Earth's "energy budget"		
				491	Earth's internal energy		

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
E2.2B Earth Science	Earth Systems	Energy in Earth Systems	Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.	178	generating electric power	262	solar energy can be used to generate electricity without producing pollution
				397	nuclear vs. fossil fuels		
				420	environmental impact of electrical generating facilities	262	determine the efficiency of a photovoltaic cell
				444	impact of using fossil fuels		
				566	description of geothermal energy		
				633	using photovoltaic cells		
				633	the efficiency of photovoltaic cells		

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
E2.2C Earth Science	Earth Systems	Energy in Earth Systems	Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation.	468 heat transfer through air 468 densely packed solids are good conductors of heat 469 convection currents and weather 469 warming hands over candle 470 convection currents in water 471 solid road surface emits radiation 471 transfer of heat by radiation 488 global warming and heat transfer by radiation 499 apply knowledge of heat transfer to different situations	192 investigate convection in liquids

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page	Volume 2 Investigation Manual Page
E2.2D Earth Science	Earth Systems	Energy in Earth Systems	Identify the main sources of energy to the climate system.	486 transfer of energy in and out of Earth's atmosphere 486 distribution of incoming solar radiation 487 Earth's "energy budget" 491 Earth's internal energy 499 convection currents in the atmosphere 501 global wind patterns 502 descriptions of ocean currents and their effects on climate 503 water in the atmosphere affects weather patterns 508 effects of moving air masses 508 cold fronts 509 jet streams 509 warm fronts 514 causes and effects of the El Nino Southern Oscillation	207 research how large bodies of water affect climate 213 exploring how temperature-dependent layering creates currents 215 understanding the Atlantic gyre

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
E2.3A Earth Science	Earth Systems	Biogeochemical Cycles	Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.	443	effects of acid rain on natural environments	178	actions to take to improve water quality
				477	nitrogen cycle	242	understanding how igneous rocks are formed and growing crystals to investigate their formation
				539	activity of Earth's crust at plate boundaries		
				540	balance of creating and consuming Earth's crust	244	understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them
				568	constructive and destructive processes		
				579	formation of igneous and sedimentary and metamorphic rocks	246	understanding and investigating how metamorphic rocks are formed
				581	identifying igneous and sedimentary and metamorphic rocks	247	interpreting how different rock formations were formed
E2.4A Earth Science	Earth Systems	Resources and Human Impacts on Earth Systems	Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.	397	nuclear vs. fossil fuels	262	solar energy can be used to generate electricity without producing pollution
				420	environmental impact of electrical generating facilities		
				444	impact of using fossil fuels		
				633	using photovoltaic cells		

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E2.4B Earth Science	Earth Systems	Resources and Human Impacts on Earth Systems	Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.	420 effect of electrical generating facilities on dissolved oxygen in water 420 electrical generation facilities and ecosystems 445 illustration of acid rain formation 449 impact of increased CO2 in oceans 485 effects of CFC's on the ozone layer 488 effects of burning fossil fuels 488 changes to the oceans due to increasing global temperatures 521 permafrost 574 how urban sprawl changes local climate	178 predict the quality of surface water to be tested and justify your answer

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
E3.1A Earth Science	The Solid Earth	Advanced Rock Cycle	Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another.	528	relative dating	225	determining the relative ages of rock formations
				529	interpreting rock formations	226	sequencing events in a geologic cross-section
				568	constructive and destructive processes	242	understanding how igneous rocks are formed and growing crystals to investigate their formation
				571	formation of soil	244	understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them
				575	studying moon rocks on Earth	246	understanding and investigating how metamorphic rocks are formed
				579	formation of igneous and sedimentary and metamorphic rocks	247	interpreting how different rock formations were formed
				581	identifying igneous and sedimentary and metamorphic rocks		
				582	the rock cycle		

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E3.1B Earth Science	The Solid Earth	Advanced Rock Cycle	Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks.	528	relative dating	225	determining the relative ages of rock formations
				529	interpreting rock formations	226	sequencing events in a geologic cross-section
				534	definition of plate tectonics	242	understanding how igneous rocks are formed and growing crystals to investigate their formation
				538	theory of plate tectonics	244	understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them
				575	studying moon rocks on Earth	246	understanding and investigating how metamorphic rocks are formed
				579	formation of igneous and sedimentary and metamorphic rocks	247	interpreting how different rock formations were formed
				581	identifying igneous and sedimentary and metamorphic rocks		
E3.2A Earth Science	The Solid Earth	Interior of the Earth	Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated.	531	formation of Earth's layers		
				532	description of Earth's layers		
				558	formation of magma in Earth's mantle		

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E3.2B Earth Science	The Solid Earth	Interior of the Earth	Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals.	543	conversion of energy in rocks causes seismic waves	
				543	causes and descriptions of earthquakes	
				544	seismic waves	
				545	earthquakes rating scales	
E3.2C Earth Science	The Solid Earth	Interior of the Earth	Describe the differences between oceanic and continental crust (including density, age, composition).	534	definition of plate tectonics	
				538	theory of plate tectonics	
E3.3A Earth Science	The Solid Earth	Plate Tectonics Theory	Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface.	534	definition of plate tectonics	
				538	theory of plate tectonics	

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page
E3.3B Earth Science	The Solid Earth	Plate Tectonics Theory	Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density.	534	definition of plate tectonics	
				538	theory of plate tectonics	
E3.3C Earth Science	The Solid Earth	Plate Tectonics Theory	Describe the motion history of geologic features (e.g., plates, Hawaii) using equations relating rate, time, and distance.	534	definition of plate tectonics	
				538	theory of plate tectonics	
E3.4A Earth Science	The Solid Earth	Earthquakes and Volcanoes	Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries.	539	describing plate boundaries	229 identifying tectonic plates and plate boundaries
				540	divergent plate boundaries	237 finding a pattern of volcanoes related to the locations of plate boundaries
				541	convergent plate boundaries	
				542	transform plate boundaries	
				561	formation of shield volcanoes due to hot spots	
				562	formation of stratovolcanoes due to subduction	

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E3.4B Earth Science	The Solid Earth	Earthquakes and Volcanoes	Describe how the sizes of earthquakes and volcanoes are measured or characterized.	543	causes and descriptions of earthquakes	236	understanding the Volcanic Explosivity Index
				543	conversion of energy in rocks causes seismic waves		
				544	seismic waves		
				545	earthquakes rating scales		
				560	types and shapes of volcanoes		
				561	shield volcanoes		
				562	stratovolcanoes		
E3.4C Earth Science	The Solid Earth	Earthquakes and Volcanoes	Describe the effects of earthquakes and volcanic eruptions on humans.	543	conversion of energy in rocks causes seismic waves	228	reading a bathymetric map
				544	seismic waves	229	using a geologic hazard map of frequent earthquakes
				546	where earthquakes occur		
				547	earthquake hazard map		
				573	geologic hazard maps		
				586	using a geologic hazard map		

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E4.1A Earth Science	The Fluid Earth	Hydrology	Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).	435	groundwater and the water cycle	178	investigating groundwater
				435	the water cycle	178	investigating the water cycle
				437	aquifers contain groundwater		
				446	oceans in the water cycle		
				565	volcanoes and water vapor		
E4.1B Earth Science	The Fluid Earth	Hydrology	Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.	435	groundwater and the water cycle	178	investigating groundwater
				437	aquifers contain groundwater		

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
E4.1C Earth Science	The Fluid Earth	Hydrology	Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	417	effects of PCB's in Great Lakes	178	predict the quality of surface water to be tested and justify your answer
				439	The Clean Water Act	179	address what you can do to maintain or improve the water quality at the test site
				441	water quality testing		
				442	water quality testing		
				443	acid rain		
				449	impact of increased CO2 on oceans	182	the effects of acid rain on organisms in aquatic environments
				450	pollution and the ocean food chain		
				451	pollution and the ocean food chain		
E4.2A Earth Science	The Fluid Earth	Oceans and Climate	Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.	499	convection currents in the atmosphere	207	research how large bodies of water affect climate
				500	the Coriolis effect	213	exploring how temperature-dependent layering creates currents
				502	descriptions of ocean currents and their effects on climate	215	understanding the Atlantic gyre
				510	rotation of air masses due to Coriolis effect		
				514	causes and effects of the El Nino Southern Oscillation		

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E4.2B Earth Science	The Fluid Earth	Oceans and Climate	Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones.	502	descriptions of ocean currents and their effects on climate	207	research how large bodies of water affect climate
				503	water in the atmosphere affects weather patterns	215	understanding the Atlantic gyre
E4.3A Earth Science	The Fluid Earth	Severe Weather	Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought).	503	factors which influence the weather	219	use radar to detect a tornado
				505	cloud formation	219	describe what safety precautions the National Weather Service recommends for tornado conditions
				511	description of thunderstorms		
				512	description of hurricanes		
				513	description of tornadoes	220	using radar to track a hurricane
				524	write an action plan to stay safe during a tornado		

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E4.3B Earth Science	The Fluid Earth	Severe Weather	Describe the damage resulting from, and the social impact of thunderstorms, tornadoes, hurricanes, and floods.	503 factors which influence the weather 505 cloud formation 511 description of thunderstorms 512 description of hurricanes 513 description of tornadoes	219 use radar to detect a tornado 220 using radar to track a hurricane
E4.3C Earth Science	The Fluid Earth	Severe Weather	Describe severe weather and flood safety and mitigation.	524 write an action plan to stay safe during a tornado	219 describe what safety precautions the National Weather Service recommends for tornado conditions
E4.3D Earth Science	The Fluid Earth	Severe Weather	Describe the seasonal variations in severe weather.	498 Earth's tilt causes seasons 524 write an action plan to stay safe during a tornado 524 create a model to explain why Earth has seasons	209 investigating factors which cause the seasons 219 describe what safety precautions the National Weather Service recommends for tornado conditions

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E4.3E Earth Science	The Fluid Earth	Severe Weather	Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).	501	global wind patterns	219	use radar to detect a tornado
				503	factors which influence the weather	220	using radar to track a hurricane
				505	cloud formation		
				508	effects of moving air masses		
				508	cold fronts		
				509	jet streams		
				509	warm fronts		
				511	description of thunderstorms		
				512	description of hurricanes		
				513	description of tornadoes		
E4.3F Earth Science	The Fluid Earth	Severe Weather	Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation.	477	composition of Earth's atmosphere	198	detecting ozone which is a protective atmosphere gas against high energy radiation
				479	definition of atmospheric pressure	217	finding relative humidity
				481	how atmospheric pressure changes with altitude		
				482	graph showing atmospheric pressure vs. altitude		
				504	phase changes in the atmosphere and dewpoint		
				507	forms of precipitation		

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E5.1A Earth Science	The Earth in Space and Time	The Earth in Space	Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.	597	characteristics of the universe	258	setting up a scale model of the solar system
				600	history of the telescope	259	determining scale distances for the planets
				601	types and uses of telescopes	260	determining scale sizes of the planets
				602	photo from the Very Large Array	264	understand why spectroscopy is an important tool of astronomers
				602	types and uses of telescopes	268	measuring apparent brightness to calculate the distance to stars and galaxies
				603	satellites as tools of astronomy		
				604	spacecraft as tools of astronomy		
				619	explanation and illustration of the solar system		
				620	relative sizes and distances within the solar system		
				639	what is a star?		
				640	the use of spectroscopy to analyze stars		
				648	what is a galaxy?		
				649	the structure of the Milky Way Galaxy		
				654	evidence for the Big Bang theory		
				655	evidence for the Big Bang theory		

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				658 research and describe astronomical objects	
E5.2A Earth Science	The Earth in Space and Time	The Sun	Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).	621 classifying the planets 628 descriptions of the sun and comparisons to other stars 630 features and diagram of the sun 631 features and emissions of the sun 641 size of the sun compare to other stars 643 H-R diagrams comparing temperature and brightness of stars	
E5.2B Earth Science	The Earth in Space and Time	The Sun	Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances.	621 classifying the planets 630 features and diagram of the sun 631 features and emissions of the sun	

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E5.2C Earth Science	The Earth in Space and Time	The Sun	Describe how nuclear fusion produces energy in the Sun.	393	fusion and fission explained	138	fusion and fission
				629	nuclear fusion and the sun	255	observe and describe the appearance of the moon and Jupiter and its moons
				644	the life cycle of stars		
				645	description and illustration of the life cycle of stars		
				646	elements formed by nuclear fusion in stars		
E5.2D Earth Science	The Earth in Space and Time	The Sun	Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	646	death of massive stars		
				646	birth of elements		
E5.3A Earth Science	The Earth in Space and Time	Earth History and Geologic Time	Explain how the solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 Ga (billion years ago).	647	how the solar system was formed		
E5.3B Earth Science	The Earth in Space and Time	Earth History and Geologic Time	Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.	399	carbon dating	160	radioactive decay
				399	radioisotopes in science and medicine	161	research pros and cons of uses for radioactive elements
				406	research pros and cons of nuclear technology		

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E5.3C Earth Science	The Earth in Space and Time	Earth History and Geologic Time	Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age.	528 529 530 530 572	relative dating faunal succession calculating Earth's age table and description of the geologic time scale ice ages	
E5.3D Earth Science	The Earth in Space and Time	Earth History and Geologic Time	Describe how index fossils can be used to determine time sequence.	529	faunal succession	
E5.4A Earth Science	The Earth in Space and Time	Climate Change	Explain the natural mechanism of the greenhouse effect, including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone).	487 491	greenhouse effect and greenhouse gasses computer modeling to predict greenhouse effects	185 effect of ocean on carbon dioxide levels in the atmosphere 202 investigate the temperature effects of greenhouse gases

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E5.4B Earth Science	The Earth in Space and Time	Climate Change	Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, and meteorite impacts).	489	global temperature changing over time	
				491	computer modeling to predict greenhouse effects	
				534	Earth's surface is changing	
E5.4C Earth Science	The Earth in Space and Time	Climate Change	Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature over the past 150 years.	487	greenhouse effect and greenhouse gasses	185 effect of ocean on carbon dioxide levels in the atmosphere 202 investigate the temperature effects of greenhouse gases

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E5.4D Earth Science	The Earth in Space and Time	Climate Change	Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans and changing climatic zones	487	greenhouse effect and greenhouse gasses	185	effect of ocean on carbon dioxide levels in the atmosphere
				515	descriptions and distribution of desert biomes	202	investigate the temperature effects of greenhouse gases
				516	different types of deserts and how they are formed	223	research a particular biome
				517	how tropical rainforests are formed		
				517	descriptions and distribution of tropical rainforest biomes		
P2.01A Physics	Motion of Objects	Position — Time	Calculate the average speed of an object using the change of position and elapsed time.	14	how to calculate speed	8	calculating speed
				20	calculate speed of car	9	collect data and calculate speed of car
				20	find speed of bumblebee	10	calculate speed of the car
				24	accurate speed measurements	12	find speed of car at different positions
				32	average speed vs. instantaneous	14	calculate speed of car at two places on the ramp
				32	average speed discussed	17	caclulate speed of car
				42	calculate speed from distance/time graph	36	find speed of marble
P2.01B Physics	Motion of Objects	Position — Time	Represent the velocities for linear and circular motion using motion diagrams (arrows on strobe pictures).	15	compare and contrast speed and velocity		

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P2.01C Physics	Motion of Objects	Position — Time	Create line graphs using measured values of position and elapsed time.	30	position vs. time graphs	13	make a position vs. time graph
P2.01D Physics	Motion of Objects	Position — Time	Describe and analyze the motion that a position-time graph represents, given the graph.	30	position vs. time graphs	13	make a position vs. time graph
P2.01E Physics	Motion of Objects	Position — Time	Describe and classify various motions in a plane as one dimensional, two dimensional, circular, or periodic.	52 185 188 188 198	the effect of gravity what is a cycle? concept of frequency explained concept of period explained analyze systems to find cycle/period/frequency	20 75 75	investigate effect of gravity on motion analyze pendulum data investigate variable that affect the period of a pendulum

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P2.01F Physics	Motion of Objects	Position — Time	Distinguish between rotation and revolution and describe and contrast the two speeds of an object like the Earth.	32	average speed discussed	8	calculating speed
				52	gravity depends on mass	20	investigate effect of gravity on motion
				52	the effect of gravity		
				54	Newton's law of universal gravitation	256	simulate an object in orbit and investigate how orbital period varies within distance
				55	calculating gravitational force between objects		
				612	Newton's law of universal gravitation	257	relating the relationship between orbital speed and distance to the equation of universal gravitation
				618	orbits of planets around the sun		
				618	Johannes Kepler		
				619	Kepler's elliptically shaped orbits		
				625	asteroids and comets		
626	meteors and meteorites and the Kuiper Belt						
P2.02A Physics	Motion of Objects	Velocity — Time	Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.	15	compare and contrast speed and velocity	8	calculating speed
				32	average speed discussed	12	calculate speed of moving car
				33	understanding acceleration	14	acceleration is the rate at which speed changes
				36	examples of acceleration		

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P2.02B Physics	Motion of Objects	Velocity — Time	Use the change of speed and elapsed time to calculate the average acceleration for linear motion.	35	how to calculate acceleration	12	calculate speed of moving car
				41	find acceleration of car	14	calculate acceleration of car on ramp
				49	link between force and acceleration	17	explore 2nd law and acceleration
				53	acceleration due to gravity		
P2.02C Physics	Motion of Objects	Velocity — Time	Describe and analyze the motion that a velocity-time graph represents, given the graph.	37	speed vs. time graphs	15	make a speed vs. time graph
P2.02D Physics	Motion of Objects	Velocity — Time	State that uniform circular motion involves acceleration without a change in speed.	36	examples of acceleration		
P3.01A Physics	Forces and Motion	Basic Forces in Nature	Identify the force(s) acting between objects in “direct contact” or at a distance.	45	Newton’s third law summarized	19	find correct relationship between force mass and acceleration
				46	force has potential to change motion	23	using 3rd law to explain common phenomena
				49	force is related to acceleration		
				59	Newton’s third law in detail		

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P3.02A Physics	Forces and Motion	Net Forces	Identify the magnitude and direction of everyday forces (e.g., wind, tension in ropes, pushes and pulls, weight).	47	weight vs. mass	20	weight vs. mass
				51	net force explained	20	investigate effect of gravity on motion
				52	the effect of gravity		
				53	how to calculate weight	21	effect of friction on the car
				56	friction explained		
				64	research effect of friction on human joints		
P3.02B Physics	Forces and Motion	Net Forces	Compare work done in different situations.	85	how to calculate work	31	calculate work done on block
				91	concept of energy as stored work	191	calculating work input and work output
				102	calculate work done		
				103	compare different amounts of work done		
				103	calculate work accomplished by a motor		
P3.02C Physics	Forces and Motion	Net Forces	Calculate the net force acting on an object.	51	net force explained		
P3.03A Physics	Forces and Motion	Newton's Third Law	Identify the action and reaction force from examples of forces in everyday situations (e.g., book on a table, walking across the floor, pushing open a door).	45	Newton's third law summarized	22	car and ramp and Newton's 3rd law
				59	Newton's third law in detail	23	using 3rd law to explain common phenomena

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P3.04A Physics	Forces and Motion	Forces and Acceleration	Predict the change in motion of an object acted on by several forces.	46	force has potential to change motion	16	unbalanced forces and acceleration of car
				49	force is related to acceleration	19	discover 2nd law of motion
				51	balanced and unbalanced forces	19	find correct relationship between force mass and acceleration
				64	solving problems using $f=ma$		
P3.04B Physics	Forces and Motion	Forces and Acceleration	Identify forces acting on objects moving with constant velocity (e.g., cars on a highway).	15	compare and contrast speed and velocity	19	find correct relationship between force mass and acceleration
				46	force has potential to change motion		
				49	force is related to acceleration		
P3.04C Physics	Forces and Motion	Forces and Acceleration	Solve problems involving force, mass, and acceleration in linear motion (Newton's second law).	64	solving problems using $f=ma$	19	discover 2nd law of motion
P3.04D Physics	Forces and Motion	Forces and Acceleration	Identify the force(s) acting on objects moving with uniform circular motion (e.g., a car on a circular track, satellites in orbit).	52	the effect of gravity	20	investigate effect of gravity on motion

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P3.06A Physics	Forces and Motion	Gravitational Interactions	Explain earth-moon interactions (orbital motion) in terms of forces.	52	gravity depends on mass	238	why studying the moon's surface is useful for understanding Earth		
				54	Newton's law of universal gravitation				
				55	calculating gravitational force between objects			250	modeling the lunar cycle
				590	the lunar cycle			251	constructing a lunar calendar
				594	lunar eclipses			257	relating the relationship between orbital speed and distance to the equation of universal gravitation
				595	solar eclipses				
				612	Newton's law of universal gravitation				
				613	properties of the moon				
				614	the moon as a satellite of Earth				
				615	the moon's effect on tides on Earth				
				616	the Earth-moon system				
617	giant impact theory								
P3.06B Physics	Forces and Motion	Gravitational Interactions	Predict how the gravitational force between objects changes when the distance between them changes.	52	gravity depends on mass	257	relating the relationship between orbital speed and distance to the equation of universal gravitation		
				54	Newton's law of universal gravitation				
				55	calculating gravitational force between objects				
				612	Newton's law of universal gravitation				

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P3.06C Physics	Forces and Motion	Gravitational Interactions	Explain how your weight on Earth could be different from your weight on another planet.	47	weight vs. mass	20	weight vs. mass
				53	how to calculate weight	24	measure force in newtons
				69	newtons and pounds		
P3.07A Physics	Forces and Motion	Electric Charges	Predict how the electric force between charged objects varies when the distance between them and/or the magnitude of charges change.	112	electrical force is incredibly strong!		
				112	electrical forces		
P3.07B Physics	Forces and Motion	Electric Charges	Explain why acquiring a large excess static charge (e.g., pulling off a wool cap, touching a Van de Graaff generator, combing) affects your hair.	111	charge is a fundamental property of matter	42	investigate electric charge
				112	static charge discussed		
				113	explanation of coulomb		
				114	how an electroscope works		
				114	electroscopes		

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P4.01A Physics	Forms of Energy and Energy Transformations	Energy Transfer	Account for and represent energy into and out of systems using energy transfer diagrams.	89	efficiency and energy transfer in natural systems	36	energy conservation and the roller coaster
				89	energy conservation and earth systems	37	investigating conservation of energy with rollercoaster
				90	energy conservation and efficiency in biological systems	38	explore energy transformations
				92	potential and kinetic energy explained	38	conservation of energy and energy transformations
				94	conservation of energy explained	39	identify type of energy involved
				95	understand basic forms of energy		
				95	energy conversions		
				96	energy transformations and conservation		
				97	different forms of energy described		
				100	energy conservation and swimming		
102	prove that energy is conserved						

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P4.01B Physics	Forms of Energy and Energy Transformations	Energy Transfer	Explain instances of energy transfer by waves and objects in everyday activities (e.g., why the ground gets warm during the day, how you hear a distant sound, why it hurts when you are hit by a baseball).	228	effect of temperature on speed of sound wave	94	does sound behave like other waves?
				228	effect of medium on speed of sound wave	119	investigate temperature and energy transfer in melting process
				460	changes in temperature are directly related to changes in energy	188	investigate the increase of temperature of water as thermal energy is added
P4.02A Physics	Forms of Energy and Energy Transformations	Energy Transformation	Account for and represent energy transfer and transformation in complex processes (interactions).	87	some input work is converted to heat	36	energy conservation and the roller coaster
				95	following an energy transformation	38	identify potential/kinetic energy conversions
				95	energy conversions	38	explore energy transformations
				96	where does "spent" energy go?		
				102	explain the "lost" energy		
				543	potential energy transformed to kinetic energy causes earthquakes		
P4.02B Physics	Forms of Energy and Energy Transformations	Energy Transformation	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).	170	what is an electromagnet?	66	build an electromagnet
				172	building an electromagnet	67	find out what happens to strength of electromagnet when current is increased
				172	increased current vs. strength of magnetic field		
				174	how electric motors work	68	investigate how an electric motor works
				176	dissecting an electric motor		

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P4.02C Physics	Forms of Energy and Energy Transformatio ns	Energy Transformation	Explain how energy is conserved in common systems (e.g., light incident on a transparent material, light incident on a leaf, mechanical energy in a collision).	89	efficiency and energy transfer in natural systems	37	investigating conservation of energy with rollercoaster
				89	energy conservation and earth systems		
				90	energy conservation and efficiency in biological systems	38	conservation of energy and energy transformations
				92	potential and kinetic energy explained		
				94	conservation of energy explained		
				96	energy transformations and conservation		
				97	different forms of energy described		
				100	energy conservation and swimming		
102	prove that energy is conserved						
P4.02D Physics	Forms of Energy and Energy Transformatio ns	Energy Transformation	Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle.	86	work input and output	31	work output vs. work input
				87	some input work is converted to heat		
				96	where does "spent" energy go?		
				102	explain the "lost" energy		

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P4.03A Physics	Forms of Energy and Energy Transformations	Kinetic and Potential Energy	Identify the form of energy in given situations (e.g., moving objects, stretched springs, rocks on cliffs, energy in food).	95	understand basic forms of energy	38	explore energy transformations
				95	energy conversions	39	identify type of energy involved
P4.03B Physics	Forms of Energy and Energy Transformations	Kinetic and Potential Energy	Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts).	95	following an energy transformation	38	identify potential/kinetic energy conversions
				543	potential energy transformed to kinetic energy causes earthquakes		
P4.03C Physics	Forms of Energy and Energy Transformations	Kinetic and Potential Energy	Explain why all mechanical systems require an external energy source to maintain their motion.	86	work input and output	31	work output vs. work input
P4.04A Physics	Forms of Energy and Energy Transformations	Wave Characteristics	Describe specific mechanical waves (e.g., on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed.	203	transverse and longitudinal waves	82	study wave pulses on elastic cord
				204	frequency and wavelength and amplitude	83	measure speed of a wave pulse
				211	standing waves on a string	83	find speed of a wave
				221	properties of sound waves	84	make different types of waves in a ripple tank
				227	importance of wavelength of sound waves	86	investigate frequency and wavelength
				248	properties of light waves		
				544	body waves	86	adjust frequency of a standing wave

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P4.04B Physics	Forms of Energy and Energy Transformations	Wave Characteristics	Identify everyday examples of transverse and compression (longitudinal) waves.	203	transverse and longitudinal waves	82	study wave pulses on elastic cord
				204	frequency and wavelength and amplitude	83	measure speed of a wave pulse
				211	standing waves on a string	84	make different types of waves in a ripple tank
				221	properties of sound waves	86	investigate frequency and wavelength
				248	properties of light waves		
				544	body waves		
P4.04C Physics	Forms of Energy and Energy Transformations	Wave Characteristics	Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency.	227	importance of wavelength of sound waves	83	find speed of a wave
				544	body waves	86	adjust frequency of a standing wave

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P4.05A Physics	Forms of Energy and Energy Transformatio ns	Mechanical Wave Propagation	Identify everyday examples of energy transfer by waves and their sources.	201 waves transmit energy 202 waves are all around us 243 light waves and the electromagnetic spectrum 243 microwave ovens 243 radio and television signals 256 identify uses of electromagnetic waves 278 identify uses of electromagnetic waves 486 energy and radiation relationships 632 the sun's energy reaches Earth in the form of electromagnetic waves	
P4.05B Physics	Forms of Energy and Energy Transformatio ns	Mechanical Wave Propagation	Explain why an object (e.g., fishing bobber) does not move forward as a wave passes under it.	201 waves transmit energy 486 electromagnetic radiation 486 energy and radiation relationships 632 the sun's energy reaches Earth in the form of electromagnetic waves	

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P4.05C Physics	Forms of Energy and Energy Transformatio ns	Mechanical Wave Propagation	Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles.	219 223 228 228	how the ear works loudness and decibels effect of temperature on speed of sound wave effect of medium on speed of sound wave	90 94	investigate human perception of sound does sound behave like other waves?
P4.05D Physics	Forms of Energy and Energy Transformatio ns	Mechanical Wave Propagation	Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source.	201 251 486 632 654	waves transmit energy we see color in terms of reflected light energy and radiation relationships the sun's energy reaches Earth in the form of electromagnetic waves the Doppler effect		
P4.05E Physics	Forms of Energy and Energy Transformatio ns	Mechanical Wave Propagation	Explain why everyone in a classroom can hear one person speaking, but why an amplification system is often used in the rear of a large concert auditorium.	225 226 226 226 232	frequency of sound and pitch sonograms voice recognition programs white noise musical instruments	90 90 98	investigate human perception of sound what is sound and how do we hear it? investigate sound and music

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P4.06A Physics	Forms of Energy and Energy Transformations	Electromagnetic Waves	Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy.	243	visible light and the electromagnetic spectrum	134	investigating visible light with a spectrometer
				243	light waves and the electromagnetic spectrum		
P4.06B Physics	Forms of Energy and Energy Transformations	Electromagnetic Waves	Explain why radio waves can travel through space, but sound waves cannot.	486	electromagnetic radiation		
P4.06C Physics	Forms of Energy and Energy Transformations	Electromagnetic Waves	Explain why there is a delay between the time we send a radio message to astronauts on the moon and when they receive it.	486	electromagnetic radiation		
P4.06D Physics	Forms of Energy and Energy Transformations	Electromagnetic Waves	Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom).	227	importance of wavelength of sound waves	83	find speed of a wave
						86	adjust frequency of a standing wave

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Standard #: Content Area	Standard	Content Statement	Performance expectation	Volume 1 Student Text Page		Volume 2 Investigation Manual Page	
P4.08A Physics	Forms of Energy and Energy Transformations	Wave Behavior — Reflection and Refraction	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.	264	forming images with lenses	106	tracing incident and reflected rays
				266	reflection and mirrors	106	investigate reflection of light
				279	find the angle of reflection	107	investigate how light interacts with mirrors
						107	plot reflected rays from a mirror
						108	explore refraction with lenses
						108	investigate how light interacts with a prism
						110	finding focal point and focal length of a lens
		111	plotting images formed when light is refracted by a lens				
				253	using a refractive telescope		
P4.08B Physics	Forms of Energy and Energy Transformations	Wave Behavior — Reflection and Refraction	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).	266	reflection and mirrors	106	tracing incident and reflected rays
				279	find the angle of reflection	106	investigate reflection of light
						107	investigate how light interacts with mirrors
						107	plot reflected rays from a mirror

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P4.09A Physics	Forms of Energy and Energy Transformations	Nature of Light	Identify the principle involved when you see a transparent object (e.g., straw, piece of glass) in a clear liquid.	264	refraction in optical systems	108	tracing incident and refracted rays
				269	index of refraction		
P4.09B Physics	Forms of Energy and Energy Transformations	Nature of Light	Explain how various materials reflect, absorb, or transmit light in different ways.	266	reflection and mirrors	106	investigate reflection of light
				486	absorption and emission	107	plot reflected rays from a mirror
P4.09C Physics	Forms of Energy and Energy Transformations	Nature of Light	Explain why the image of the Sun appears reddish at sunrise and sunset.	248	visible light wavelengths and color	101	observing white light through diffraction grating
				248	color and frequency of light waves	105	explore relationship between color and wavelength
				269	using a prism to show different colors in white light	265	an element's spectral lines correspond to specific wavelengths of light

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P4.10A Physics	Forms of Energy and Energy Transformatio ns	Current Electricity — Circuits	Describe the energy transformations when electrical energy is produced and transferred to homes and businesses.	126	alternating current	66	build an electromagnet
				126	direct current	67	find out what happens to strength of electromagnet when current is increased
				170	what is an electromagnet?		
				172	building an electromagnet	262	determine the efficiency of a photovoltaic cell
				172	increased current vs. strength of magnetic field		
				178	generating electric power		
				566	description of geothermal energy		
633	the efficiency of photovoltaic cells						
P4.10B Physics	Forms of Energy and Energy Transformatio ns	Current Electricity — Circuits	Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.	126	ground fault circuit interrupter	48	measuring resistance
				129	understand the concept of electrical resistance		
				134	find and investigate circuit breakers in the home		
				141	potentiometer explained		

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P4.10C Physics	Forms of Energy and Energy Transformatio ns	Current Electricity — Circuits	Given diagrams of many different possible connections of electric circuit elements, identify complete circuits, open circuits, and short circuits and explain the reasons for the classification.	108	concept of electric circuits	45	battery chemicals and electrical charge
				109	circuit diagrams	56	build a parallel circuit
				119	battery uses chemical energy to produce electrical charge	56	build a series circuit
				151	parallel circuit defined	58	build a series circuit and find total resistance
				151	series circuit defined	60	parallel circuit and Ohm's law
				152	household wiring		
				153	current and voltage in series circuits		
				157	voltage and resistance in parallel circuits		
				161	analyze a parallel circuit		
				162	analyze a series circuit		

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P4.10D Physics	Forms of Energy and Energy Transformations	Current Electricity — Circuits	Discriminate between voltage, resistance, and current as they apply to an electric circuit.	107	concept of electric current	44	investigate concept of voltage
				120	voltage and potential energy	46	investigate concept of electric current
				120	voltage is related to potential energy	48	measuring resistance
				121	how to measure voltage	50	Ohm's law
				123	electrical current explained		
				125	how to measure current		
				129	understand the concept of electrical resistance		
				135	Ohm's law explained		
				138	using Ohm's law to analyze circuits		
				141	potentiometer explained		
P4.12A Physics	Forms of Energy and Energy Transformations	Nuclear Reactions	Describe peaceful technological applications of nuclear fission and radioactive decay.	399	carbon dating	161	research pros and cons of uses for radioactive elements
				399	radioisotopes in science and medicine		
				406	research pros and cons of nuclear technology		
P4.12B Physics	Forms of Energy and Energy Transformations	Nuclear Reactions	Describe possible problems caused by exposure to prolonged radioactive decay.	394	nuclear vs chemical reactions	138	nuclear reactions
				397	half-life	160	how do you simulate nuclear decay?
				405	find the half-life of a radioactive isotope		

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P4.12C Physics	Forms of Energy and Energy Transformatio ns	Nuclear Reactions	Explain how stars, including our Sun, produce huge amounts of energy (e.g., visible, infrared, ultraviolet light).	393 fusion and fission explained 621 classifying the planets 629 nuclear fusion and the sun 630 features and diagram of the sun 631 features and emissions of the sun	138 fusion and fission