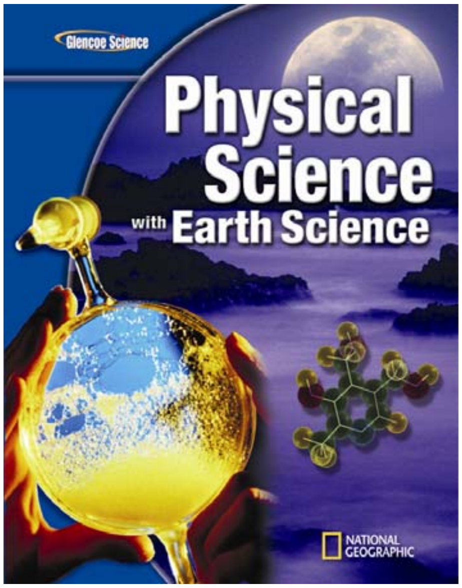
McGraw Hill Glencoe

High School Science Content Expectations
Physics/Earth Science/Chemistry
Essential Skills



Physical Science with Earth Science

STANDARDS	PAGE REFERENCES
PHYSICS	
STANDARD P1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS *Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.*	
P1.1 Scientific Inquiry Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.	

Codes used for Teacher Wraparound Edition pages are the initial caps of headings on that page.

STANDARDS		PAGE REFERENCES
P1.1A	Generate new questions that can be investigated in the laboratory or field.	**Student Edition:** 6-10, 12, 38-39, 42-45, 54-57 *Design Your Own LAB* 88-89 *LAB* 27, 51 *Model and Invent LAB* 176-177 *Science Skill Handbook* 850 **Teacher Wraparound Edition:** D 39; IM 43; LD 54; PR 50
P1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	**Student Edition:** 10, 14-21 *Accidents in Science* 210 *Design Your Own LAB* 28-29, 144-145, 568-569 *Launch Lab* 3, 185, 785 *Science Skill Handbook* 850-858 **Teacher Wraparound Edition:** FF 8; SJ 11
P1.1C	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).	**Student Edition:** 14-21 *Design Your Own LAB* 28-29 *LAB* 27, 196, 300, 775 *Launch Lab* 69, 645 *MiniLAB* 19, 71 *Model and Invent LAB* 176-177 *National Geographic* 18 **Teacher Wraparound Edition:** LD 54; QD 17
P1.1D	Identify patterns in data and relate them to theoretical models.	**Student Edition:** 11, 194, 199-202, 492-493, 823-824 *LAB* 597, 830 *National Geographic* 292, 548-549, 826 *Science and History* 600 **Teacher Wraparound Edition:** CC 39; DI 10; IL 202

STANDARDS		PAGE REFERENCES
P1.1E	Describe a reason for a given conclusion using evidence from an investigation.	**Student Edition:** 6-10, 12-13 *Design Your Own LAB* 414-415, 568-569 *LAB* 196, 406 *Model and Invent LAB* 840-841 *Science and History* 146, 478 *Science and Society* 778 *Science Skill Handbook* 858 **Teacher Wraparound Edition:** DI 553; FYI 404; QD 10
	P1.2 Scientific Reflection and Social Implications The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.	
P1.2A	Critique whether or not specific questions can be answered through scientific investigations.	**Student Edition:** 6-10, 38-45, 46-50 *MiniLAB* 40 **Teacher Wraparound Edition:** CC 10; D 39; DI 7
P1.2B	Identify and critique arguments about personal or societal issues based on scientific evidence.	**Student Edition:** 42-45, 46-50 *LAB* 51 *Model and Invent LAB* 58-59 **Teacher Wraparound Edition:** A 48; DI 44; PR 50
P1.2C	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	**Student Edition:** 8, 14-21 *Science Skill Handbook* 850 **Teacher Wraparound Edition:** CD 8

STANDARDS		PAGE REFERENCES
P1.2D	Evaluate scientific explanations in a peer review process or discussion format.	**Student Edition:** 10, 46-49 *Design Your Own LAB* 88-89 *LAB* 51, 87, 112, 118-119, 134 *Model and Invent LAB* 58-59 **Teacher Wraparound Edition:** A 48; CYD 59
P1.2E	Evaluate the future career and occupational prospects of science fields.	**Student Edition:** *Applying Science* 49 *Integrate Career* 56, 408, 440, 472, 592, 753 **Teacher Wraparound Edition:** IC 56, 408, 440, 472, 592, 753; IE 139; R 57
	STANDARD P2: MOTION OF OBJECTS *The universe is in a state of constant change. From small particles (electrons) to the large systems (galaxies) all things are in motion. Therefore, for students to understand the universe they must describe and represent various types of motion. Kinematics, the description of motion, always involves measurements of position and time. Students must describe the relationships between these quantities using mathematical statements, graphs, and motion maps. They use these representations as powerful tools to not only describe past motions but also predict future events.*	
	P2.1 Position – Time An object's position can be measured and graphed as a function of time. An object's speed can be calculated and graphed as a function of time.	
P2.1A	Calculate the average speed of an object using the change of position and elapsed time.	**Student Edition:** 71-72 *Applying Math* 72 *Design Your Own LAB* 88-89 *Launch Lab* 69 *MiniLAB* 71 **Teacher Wraparound Edition:** DI 72; IM 74
P2.1B	Represent the velocities for linear and circular motion using motion diagrams (arrows on strobe pictures).	**Student Edition:** 73-75, 77 *National Geographic* 78 **Teacher Wraparound Edition:** IM 74

STANDARDS		PAGE REFERENCES
P2.1C	Create line graphs using measured values of position and elapsed time.	**Student Edition:** 74-75 *Design Your Own LAB* 88-89 *Launch Lab* 69 *Science Skill Handbook* 875-876 **Teacher Wraparound Edition:** PR 75
P2.1D	Describe and analyze the motion that a position-time graph represents, given the graph.	**Student Edition:** 74-75 *Design Your Own LAB* 88-89 **Teacher Wraparound Edition:** AS 75; FYI 74
P2.1E	Describe and classify various motions in a plane as one dimensional, two dimensional, circular, or periodic.	**Student Edition:** 73-75, 77, 110-111, 295 *National Geographic* 78 **Teacher Wraparound Edition:** IM 74
P2.1F	Distinguish between rotation and revolution and describe and contrast the two speeds of an object like the Earth.	**Student Edition:** 190-192, 197, 524-525 **Teacher Wraparound Edition:** IM 198; USW 192
	P2.2 Velocity — Time The motion of an object can be described by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.	
P2.2A	Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.	**Student Edition:** 70-73, 76-80 *Launch Lab* 69 *National Geographic* 78 **Teacher Wraparound Edition:** FYI 78; IM 72, 74; LD 79; VL 71
P2.2B	Use the change of speed and elapsed time to calculate the average acceleration for linear motion.	**Student Edition:** 76-79 *National Geographic* 78 **Teacher Wraparound Edition:** D 70; FYI 78

STANDARDS		PAGE REFERENCES
P2.2C	Describe and analyze the motion that a velocity-time graph represents, given the graph.	**Student Edition:** 77-79 *National Geographic* 78 **Teacher Wraparound Edition:** DI 78
P2.2D	State that uniform circular motion involves acceleration without a change in speed.	**Student Edition:** 73, 77, 110-111 **Teacher Wraparound Edition:** DI 110
	P2.3x Frames of Reference All motion is relative to whatever frame of reference is chosen, for there is no motionless frame from which to judge all motion.	
	STANDARD P3: FORCES AND MOTION *Students identify interactions between objects either as being by direct contact (e.g., pushes or pulls, friction) or at a distance (e.g., gravity, electromagnetism), and to use forces to describe interactions between objects. They recognize that non-zero net forces always cause changes in motion (Newton's first law). These changes can be changes in speed, direction, or both. Students use Newton's second law to summarize relationships among and solve problems involving net forces, masses, and changes in motion (using standard metric units). They explain that whenever one object exerts a force on another, a force equal in magnitude and opposite in direction is exerted back on it (Newton's third law).*	
	P3.1 Basic Forces in Nature Objects can interact with each other by "direct contact" (e.g., pushes or pulls, friction) or at a distance (e.g., gravity, electromagnetism, nuclear).	
P3.1A	Identify the force(s) acting between objects in "direct contact" or at a distance.	**Student Edition:** 81-84, 104-107, 110-111, 113-117, 161, 392-399, 424-427, 786-788 *LAB* 87, 112 **Teacher Wraparound Edition:** FF 105; LD 83; QD 115, 426, 788; USW 110

STANDARDS		PAGE REFERENCES
	P3.1x Forces There are four basic forces (gravitational, electromagnetic, strong, and weak nuclear) that differ greatly in magnitude and range. Between any two charged particles, electric force is vastly greater than the gravitational force. Most observable forces (e.g., those exerted by a coiled spring or friction) may be traced to electric forces acting between atoms and molecules.	
	P3.2 Net Forces Forces have magnitude and direction. The net force on an object is the sum of all the forces acting on the object. Objects change their speed and/or direction only when a net force is applied. If the net force on an object is zero, there is no change in motion (Newton's First Law).	
P3.2A	Identify the magnitude and direction of everyday forces (e.g., wind, tension in ropes, pushes and pulls, weight).	**Student Edition:** 82-86, 98-103, 106-111, 162-164, 166-174 *LAB* 87, 112 *Model and Invent LAB* 176-177 *National Geographic* 115, 168 *Science and History* 312 **Teacher Wraparound Edition:** A 85, 108; DI 109; IM 82; LD 102
P3.2B	Compare work done in different situations.	**Student Edition:** 154-157, 160-165, 166-174 *Model and Invent LAB* 176-177 **Teacher Wraparound Edition:** FF 158; QD 156; SJ 162
P3.2C	Calculate the net force acting on an object.	**Student Edition:** 82, 85-86, 102-103, 169-170 *LAB* 87 *Model and Invent LAB* 176-177 **Teacher Wraparound Edition:** D 86; VL 82
	P3.3 Newton's Third Law Whenever one object exerts a force on another object, a force equal in magnitude and opposite in direction is exerted back on the first object.	
P3.3A	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).	**Student Edition:** 106-107, 113-114, 116-117 *LAB* 112 *National Geographic* 115 **Teacher Wraparound Edition:** CU 117; DI 100, 106; FF 115; LD 102; R 103; SJ 114

STANDARDS		PAGE REFERENCES
	P3.4 Forces and Acceleration The change of speed and/or direction (acceleration) of an object is proportional to the net force and inversely proportional to the mass of the object. The acceleration and net force are always in the same direction.	
P3.4A	Predict the change in motion of an object acted on by several forces.	**Student Edition:** 82-84, 98-99, 102-103 *LAB* 87 **Teacher Wraparound Edition:** LD 102; VL 82
P3.4B	Identify forces acting on objects moving with constant velocity (e.g., cars on a highway).	**Student Edition:** 81-84, 98-100 *LAB* 87 **Teacher Wraparound Edition:** D 86; DI 100; IM 82; LD 102
P3.4C	Solve problems involving force, mass, and acceleration in linear motion (Newton's second law).	**Student Edition:** 101-103, 106-107 **Teacher Wraparound Edition:** A 108; D 107; FF 105
P3.4D	Identify the force(s) acting on objects moving with uniform circular motion (e.g., a car on a circular track, satellites in orbit).	**Student Edition:** 73, 77, 110-111 **Teacher Wraparound Edition:** DI 110
	P3.5x Momentum A moving object has a quantity of motion (momentum) that depends on its velocity and mass. In interactions between objects, the total momentum of the objects does not change.	
	P3.6 Gravitational Interactions Gravitation is a universal attractive force that a mass exerts on every other mass. The strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.	
P3.6A	Explain earth-moon interactions (orbital motion) in terms of forces.	**Student Edition:** 104-105, 110-111 **Teacher Wraparound Edition:** FF 105; FYI 199
P3.6B	Predict how the gravitational force between objects changes when the distance between them changes.	**Student Edition:** 104-105 **Teacher Wraparound Edition:** FF 105; FYI 107

STANDARDS		PAGE REFERENCES
P3.6C	Explain how your weight on Earth could be different from your weight on another planet.	**Student Edition:** 106-108 **Teacher Wraparound Edition:** FF 105; SJ 106
	P3.7 Electric Charges Electric force exists between any two charged objects. Oppositely charged objects attract, while objects with like charge repel. The strength of the electric force between two charged objects is proportional to the magnitudes of the charges and inversely proportional to the square of the distance between them (Coulomb's Law).	
P3.7A	Predict how the electric force between charged objects varies when the distance between them and/or the magnitude of charges change.	**Student Edition:** 393-394, 396 **Teacher Wraparound Edition:** A 393
P3.7B	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.	**Student Edition:** 393 **Teacher Wraparound Edition:** CU 399; SJ 393; TPK 392
	P3.7x Electric Charges — Interactions Charged objects can attract electrically neutral objects by induction.	
	P3.p8 Magnetic Force *(prerequisite)* Magnets exert forces on all objects made of ferromagnetic materials (e.g., iron, cobalt, and nickel) as well as other magnets. This force acts at a distance. Magnetic fields accompany magnets and are related to the strength and direction of the magnetic force. *(prerequisite)*	
	P3.8x Electromagnetic Force Magnetic and electric forces are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces and moving magnets produce electric forces (e.g., electric current in a conductor).	

STANDARDS		PAGE REFERENCES
STANDARD P4: FORMS OF ENERGY AND ENERGY TRANSFORMATIONS *Energy is a useful conceptual system for explaining how the universe works and accounting for changes in matter. Energy is not a "thing." Students develop several energy-related ideas: First, they keep track of energy during transfers and transformations, and account for changes using energy conservation. Second, they identify places where energy is apparently lost during a transformation process, but is actually spread around to the environment as thermal energy and therefore not easily recoverable. Third, they identify the means of energy transfers: collisions between particles, or waves.*		
P4.1 Energy Transfer Moving objects and waves transfer energy from one location to another. They also transfer energy to objects during interactions (e.g., sunlight transfers energy to the ground when it warms the ground; sunlight also transfers energy from the Sun to the Earth).		
P4.1A	Account for and represent energy into and out of systems using energy transfer diagrams.	**Student Edition:** 128-129, 132-133, 137-140, 142-143, 155, 159 *Design Your Own LAB* 144-145 *LAB* 124 *National Geographic* 138 **Teacher Wraparound Edition:** AS 143; CU 159; QD 136; SJ 139, 155
P4.1B	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).	**Student Edition:** 128-129, 135-141, 266-267, 301-302, 321-322 *LAB* 134 *Launch Lab* 127 **Teacher Wraparound Edition:** CC 298; IL 274; QD 136; SJ 138; TPK 288
P4.1x Energy Transfer — Work Work is the amount of energy transferred during an interaction. In mechanical systems, work is the amount of energy transferred as an object is moved through a distance, $W = F d$, where d is in the same direction as F. The total work done on an object depends on the net force acting on the object and the object's displacement.		
P4.2 Energy Transformation Energy is often transformed from one form to another. The amount of energy before a transformation is equal to the amount of energy after the transformation. In most energy transformations, some energy is converted to thermal energy.		
P4.2A	Account for and represent energy transfer and transformation in complex processes (interactions).	**Student Edition:** 128-133, 135-139, 159 *Design Your Own LAB* 144-145 *Launch Lab* 127 *National Geographic* 138 **Teacher Wraparound Edition:** LD 138; QD 136; R 133; SJ 139

STANDARDS		PAGE REFERENCES
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).	**Student Edition:** 159, 162-163, 275-276, 325-326, 404-405, 486-487, 494-497 *Design Your Own LAB* 446-447 *National Geographic* 441 **Teacher Wraparound Edition:** A 275; FYI 325; QD 163
P4.2C	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).	**Student Edition:** 139-140, 163, 274, 734 *Design Your Own LAB* 144-145 *Integrate Environment* 139 *National Geographic* 138 **Teacher Wraparound Edition:** LD 138
P4.2D	Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle.	**Student Edition:** 136, 164-165 *Integrate History* 273 *LAB* 134 *Science and History* 146 **Teacher Wraparound Edition:** AS 165; FF 275; QD 136; VL 136
	P4.3 Kinetic and Potential Energy Moving objects have kinetic energy. Objects experiencing a force may have potential energy due to their relative positions (e.g., lifting an object or stretching a spring, energy stored in chemical bonds). Conversions between kinetic and gravitational potential energy are common in moving objects. In frictionless systems, the decrease in gravitational potential energy is equal to the increase in kinetic energy or vice versa.	
P4.3A	Identify the form of energy in given situations (e.g., moving objects, stretched springs, rocks on cliffs, energy in food).	**Student Edition:** 130-133, 135-137, 143, 320-321, 407-413, 462-467, 501-505 *Design Your Own LAB* 144-145 *Integrate Environment* 139 *LAB* 134 **Teacher Wraparound Edition:** CB 142; FF 129; FYI 412; QD 132; SJ 139; VL 136

STANDARDS		PAGE REFERENCES
P4.3B	Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts).	**Student Edition:** 136-140 *Design Your Own LAB* 144-145 *LAB* 134 *National Geographic* 138 **Teacher Wraparound Edition:** IL 141; IM 137
P4.3C	Explain why all mechanical systems require an external energy source to maintain their motion.	**Student Edition:** 140, 164-165 *Integrate History* 273 *LAB* 134 *Science and History* 146 **Teacher Wraparound Edition:** AS 165; FF 275; QD 136
	P4.3x Kinetic and Potential Energy — Calculations The kinetic energy of an object is related to the mass of an object and its speed: $KE = \frac{1}{2} mv^2$.	
	P4.4 Wave Characteristics Waves (mechanical and electromagnetic) are described by their wavelength, amplitude, frequency, and speed.	
P4.4A	Describe specific mechanical waves (e.g., on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed.	**Student Edition:** 294-299 *LAB* 300, 310-311 *National Geographic* 292 **Teacher Wraparound Edition:** CC 297; QD 296
P4.4B	Identify everyday examples of transverse and compression (longitudinal) waves.	**Student Edition:** 290-291 *Integrate Earth Science* 293 *National Geographic* 292 **Teacher Wraparound Edition:** CB 292; CU 293; FYI 290
P4.4C	Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency.	**Student Edition:** 295-296, 298-299 **Teacher Wraparound Edition:** CC 297; VL 296

STANDARDS		PAGE REFERENCES
	P4.4x Wave Characteristics — Calculations Wave velocity, wavelength, and frequency are related by $v = \lambda f$. The energy transferred by a wave is proportional to the square of the amplitude of vibration and its frequency.	
	P4.5 Mechanical Wave Propagation Vibrations in matter initiate mechanical waves (e.g., water waves, sound waves, seismic waves), which may propagate in all directions and decrease in intensity in proportion to the distance squared for a point source. Waves transfer energy from one place to another without transferring mass.	
P4.5A	Identify everyday examples of energy transfer by waves and their sources.	**Student Edition:** 288-291, 326 *Integrate Earth Science* 293 *National Geographic* 368, 805 *Science and History* 312, 448 **Teacher Wraparound Edition:** CD 306; TC 318; VL 291
P4.5B	Explain why an object (e.g., fishing bobber) does not move forward as a wave passes under it.	**Student Edition:** 290-291 **Teacher Wraparound Edition:** QD 289
P4.5C	Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles.	**Student Edition:** 290-291, 320-322, 326 **Teacher Wraparound Edition:** FF 307; IM 321
P4.5D	Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source.	**Student Edition:** 308-309, 320-323 *Integrate Earth Science* 293 *National Geographic* 292 **Teacher Wraparound Edition:** FYI 322; IES 292
P4.5E	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.	**Student Edition:** 322 **Teacher Wraparound Edition:** FYI 322

STANDARDS		PAGE REFERENCES
	P4.6 Electromagnetic Waves Electromagnetic waves (e.g., radio, microwave, infrared, visible light, ultraviolet, x-ray) are produced by changing the motion (acceleration) of charges or by changing magnetic fields. Electromagnetic waves can travel through matter, but they do not require a material medium. (That is, they also travel through empty space.) All electromagnetic waves move in a vacuum at the speed of light. Types of electromagnetic radiation are distinguished from each other by their wavelength and energy.	
P4.6A	Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy.	**Student Edition:** 462-467, 469-475, 822 **Teacher Wraparound Edition:** D 466; IL 464; QD 465
P4.6B	Explain why radio waves can travel through space, but sound waves cannot.	**Student Edition:** 288-289, 456, 463, 469-470 **Teacher Wraparound Edition:** IM 289
P4.6C	Explain why there is a delay between the time we send a radio message to astronauts on the moon and when they receive it.	**Student Edition:** 463, 469-470, 474 *National Geographic* 471 **Teacher Wraparound Edition:** TPK 469
P4.6D	Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom).	**Student Edition:** 296 *Science and History* 478 **Teacher Wraparound Edition:** TC 318
	P4.6x Electromagnetic Propagation Modulated electromagnetic waves can transfer information from one place to another (e.g., televisions, radios, telephones, computers and other information technology devices). Digital communication makes more efficient use of the limited electromagnetic spectrum, is more accurate than analog transmission, and can be encrypted to provide privacy and security.	
	P4.r7x Quantum Theory of Waves *(recommended)* Electromagnetic energy is transferred on the atomic scale in discrete amounts called quanta. The equation $E = h f$ quantifies the relationship between the energy transferred and the frequency, where h is Planck's constant. *(recommended)*	

STANDARDS		PAGE REFERENCES
	P4.8 Wave Behavior — Reflection and Refraction The laws of reflection and refraction describe the relationships between incident and reflected/refracted waves.	
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.	**Student Edition:** 327-330 *National Geographic* 334 **Teacher Wraparound Edition:** IM 328; R 330; VL 329
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).	**Student Edition:** 328 **Teacher Wraparound Edition:** CU 330; DI 328
	P4.8x Wave Behavior — Diffraction, Interference, and Refraction Waves can bend around objects (diffraction). They also superimpose on each other and continue their propagation without a change in their original properties (interference). When refracted, light follows a defined path.	
	P4.9 Nature of Light Light interacts with matter by reflection, absorption, or transmission.	
P4.9A	Identify the principle involved when you see a transparent object (e.g., straw, piece of glass) in a clear liquid.	**Student Edition:** 327 **Teacher Wraparound Edition:** D 329; FYI 328; MC 327
P4.9B	Explain how various materials reflect, absorb, or transmit light in different ways.	**Student Edition:** 327-329, 339 *LAB* 338 **Teacher Wraparound Edition:** MM 328; QD 333
P4.9C	Explain why the image of the Sun appears reddish at sunrise and sunset.	**Student Edition:** 339 *Integrate Earth Science* 542 **Teacher Wraparound Edition:** DI 557; IES 542

STANDARDS	PAGE REFERENCES
P4.r9x Nature of Light — Wave-Particle Nature *(recommended)* The dual wave-particle nature of matter and light is the foundation for modern physics. *(recommended)*	
P4.10 Current Electricity — Circuits Current electricity is described as movement of charges. It is a particularly useful form of energy because it can be easily transferred from place to place and readily transformed by various devices into other forms of energy (e.g., light, heat, sound, and motion). Electrical current (amperage) in a circuit is determined by the potential difference (voltage) of the power source and the resistance of the loads in the circuit.	
P4.10A Describe the energy transformations when electrical energy is produced and transferred to homes and businesses.	**Student Edition:** 407-413 *Applying Math* 412 **Teacher Wraparound Edition:** A 409
P4.10B Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.	**Student Edition:** 407-410, 413 *Applying Math* 411, 412 **Teacher Wraparound Edition:** CD 410
P4.10C 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.	**Student Edition:** 400-401, 404-405, 407-410 *Design Your Own LAB* 414-415 *Launch Lab* 391 **Teacher Wraparound Edition:** MM 410
P4.10D Discriminate between voltage, resistance, and current as they apply to an electric circuit.	**Student Edition:** 404-405, 410-411 **Teacher Wraparound Edition:** R 405; SJ 411
P4.10x Current Electricity — Ohm's Law, Work, and Power In circuits, the relationship between electric current, I, electric potential difference, V, and resistance, R, is quantified by $V = I R$ (Ohm's Law). Work is the amount of energy transferred during an interaction. In electrical systems, work is done when charges are moved through the circuit. Electric power is the amount of work done by an electric current in a unit of time, which can be calculated using $P = I V$.	
P4.11x Heat, Temperature, and Efficiency Heat is often produced as a by-product during energy transformations. This energy is transferred into the surroundings and is not usually recoverable as a useful form of energy. The efficiency of systems is defined as the ratio of the useful energy output to the total energy input. The efficiency of natural and human-made systems varies due to the amount of heat that is not recovered as useful work.	

STANDARDS	PAGE REFERENCES
P4.12 Nuclear Reactions Changes in atomic nuclei can occur through three processes: fission, fusion, and radioactive decay. Fission and fusion can convert small amounts of matter into large amounts of energy. Fission is the splitting of a large nucleus into smaller nuclei at extremely high temperature and pressure. Fusion is the combination of smaller nuclei into a large nucleus and is responsible for the energy of the Sun and other stars. Radioactive decay occurs naturally in the Earth's crust (rocks, minerals) and can be used in technological applications (e.g., medical diagnosis and treatment).	
P4.12A Describe peaceful technological applications of nuclear fission and radioactive decay.	**Student Edition:** 792, 794-795, 804-806 *National Geographic* 805 **Teacher Wraparound Edition:** CC 794; FF 803; FYI 792; SJ 802
P4.12B Describe possible problems caused by exposure to prolonged radioactive decay.	**Student Edition:** 792-793, 800 **Teacher Wraparound Edition:** D 799; IM 788; QD 798; RS 792; SJ 802
P4.12C Explain how stars, including our Sun, produce huge amounts of energy (e.g., visible, infrared, ultraviolet light).	**Student Edition:** 824-825, 827-829 **Teacher Wraparound Edition:** IM 827; USW 825
P4.12x Mass and Energy In nuclear reactions, a small amount of mass is converted to a large amount of energy, $E = mc^2$, where c is the speed of light in a vacuum. The amount of energy before and after nuclear reactions must consider mass changes as part of the energy transformation.	

STANDARDS		PAGE REFERENCES
	EARTH SCIENCE	
	STANDARD E1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS *Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.*	
	E1.1 Scientific Inquiry Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.	
E1.1A	Generate new questions that can be investigated in the laboratory or field.	**Student Edition:** *Design Your Own Lab* 144-145 *Lab* 338, 445 **Teacher Wraparound Edition:** ACT 9; AIL 88, 118, 278, 310, 344, 414, 446, 541; IL 306, 367, 564
E1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	**Student Edition:** 7-10 *Communicating Your Data* 559 *Design Your Own Lab* 28-29, 88-89, 144-145, 242-243, 344-345, 414-415, 446-447, 540-541, 568-569 *Lab* 380-381 *Model and Invent Lab* 808-809 **Teacher Wraparound Edition:** EA 119, 279
E1.1C	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).	**Student Edition:** *Design Your Own Lab* 88-89, 144-145, 242-243, 344-345, 414-415, 446-447, 540-541, 568-569 *Lab* 87, 196, 278-279, 406, 523, 559 *Model and Invent Lab* 176-177

STANDARDS		PAGE REFERENCES
E1.1D	Identify patterns in data and relate them to theoretical models.	*Design Your Own Lab* 88-89, 144-145, 414-415, 540-541, 568-569 *Lab* 112, 118-119, 134, 278-279, 300, 380-381 *MiniLab* 219 *Model and Invent Lab* 176-177 *Science Online* 374 **Teacher Wraparound Edition:** CYD 311
E1.1E	Describe a reason for a given conclusion using evidence from an investigation.	**Student Edition:** *Design Your Own Lab* 88-89, 144-145, 242-243, 344-345, 414-415, 446-447, 540-541, 568-569 *Lab* 112, 118-119, 230, 278-279, 445, 523 *Model and Invent Lab* 176-177

E1.2 Scientific Reflection and Social Implications

The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.

STANDARDS		PAGE REFERENCES
E1.2A	Critique whether or not specific questions can be answered through scientific investigations.	**Teacher Wraparound Edition:** DI 7
E1.2B	Identify and critique arguments about personal or societal issues based on scientific evidence.	**Student Edition:** 12 *Integrate Environment* 667 *Science and Society* 510 *Science Online* 45 **Teacher Wraparound Edition:** A 45, 539; ACT 498; CC 495; DIS 244; PR 12, 539

STANDARDS	PAGE REFERENCES
E1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	**Student Edition:** 8, 10, 14-21, 581-583, 588-589 *Integrate Astronomy* 596 *Science and History* 146, 312, 448 *Science Online* 101, 204, 227 *Science Skill Handbook* 850 *Use the Internet Lab* 476-477, 508-509, 598-599 **Teacher Wraparound Edition:** ACT 101; CC 10; CD 8; DI 586; DIS 224; SJ 55
E1.2D Evaluate scientific explanations in a peer review process or discussion format.	**Student Edition:** *Communicating Your Data* 29, 51, 89, 243, 279, 447, 507, 569, 637, 777 *Use the Internet Lab* 476-477, 508-509, 598-599 **Teacher Wraparound Edition:** CYD 230; EA 345
E1.2E Evaluate the future career and occupational prospects of science fields.	**Student Edition:** *Integrate Career* 56, 114, 335, 408, 440, 472, 592, 753 **Teacher Wraparound Edition:** C 17, 565; CD 132; DI 397; UP 549
STANDARD E2: EARTH SYSTEMS *Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.*	
E2.1 Earth Systems Overview The Earth is a system consisting of four major interacting components: geosphere (crust, mantle, and core), atmosphere (air), hydrosphere (water), and biosphere (the living part of Earth). Physical, chemical, and biological processes act within and among the four components on a wide range of time scales to continuously change Earth's crust, oceans, atmosphere, and living organisms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of geochemical cycles.	
E2.1A Explain why the Earth is essentially a closed system in terms of matter.	**Student Edition:** 385 #18, 634-635, 646, 663 **Teacher Wraparound Edition:** TC 606

STANDARDS		PAGE REFERENCES
E2.1B	Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.	**Student Edition:** 518-522, 524-525, 529-534 *Integrate Earth Science* 108, 258 *Integrate Life Science* 428, 522 *National Geographic* 268, 292, 397, 531 **Teacher Wraparound Edition:** DI 292; DIS 526; V 268, 292
E2.1C	Explain, using specific examples, how a change in one system affects other Earth systems.	**Student Edition:** 293, 373-378, 354-361, 565-566 *Integrate History* 377 *Science and History* 382 *Science Online* 376 **Teacher Wraparound Edition:** CB 382; MM 530; QD 520
	E2.2 Energy in Earth Systems Energy in Earth systems can exist in a number of forms (e.g., thermal energy as heat in the Earth, chemical energy stored as fossil fuels, mechanical energy as delivered by tides) and can be transformed from one state to another and move from one reservoir to another. Movement of matter and its component elements, through and between Earth's systems, is driven by Earth's internal (radioactive decay and gravity) and external (Sun as primary) sources of energy. Thermal energy is transferred by radiation, convection, and conduction. Fossil fuels are derived from plants and animals of the past, are nonrenewable, and, therefore, are limited in availability. All sources of energy for human consumption (e.g., solar, wind, nuclear, ethanol, hydrogen, geothermal, hydroelectric) have advantages and disadvantages.	
E2.2A	Describe the Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy).	**Student Edition:** 269, 505, 520, 786-790 **Teacher Wraparound Edition:** DIS 505
E2.2B	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.	**Student Edition:** 485-493, 494-500, 501-506 *Lab* 507 *Launch Lab* 488 *MiniLab* 502 *National Geographic* 488 *Science Online* 505 **Teacher Wraparound Edition:** A 493; ACT 488; DIS 487, 503; QD 491; SCB 484E-F; V 488

STANDARDS		PAGE REFERENCES
E2.2C	Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation.	**Student Edition:** 266-270 *Lab* 271, 278-279 *MiniLab* 519 *National Geographic* 268 **Teacher Wraparound Edition:** A 271; AIL 278; IM 269; QD 268; RS 268; SCB 252E-F, 516E; USW 269; V 268, 397
E2.2D	Identify the main sources of energy to the climate system.	**Student Edition:** 193-195, 529-534, 535-539 *Integrate Earth Science* 258 *MiniLab* 195 *National Geographic* 268 **Teacher Wraparound Edition:** ACT 193; CFU 534; DIS 532; LD 193; QD 536; TFYI 532; VL 194
	E2.3 Biogeochemical Cycles The Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different states and chemical forms; they move within and between the geosphere, atmosphere, hydrosphere, and biosphere as part of the Earth system. The movements can be slow or rapid. Elements and compounds have significant impacts on the biosphere and have important impacts on human health.	
E2.3A	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.	**Student Edition:** 492, 518-519, 536-537, 648, 795 *Applying Math* 537 *Integrate Chemistry* 613 *Integrate Life Science* 586 **Teacher Wraparound Edition:** IM 613; RS 537

STANDARDS		PAGE REFERENCES
	E2.4 Resources and Human Impacts on Earth Systems The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of nonrenewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long-term climate. Plans for land use and long-term development must include an understanding of the interactions between Earth systems and human activities.	
E2.4A	Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.	**Student Edition:** 485-493, 501-506 *Science Online* 498 *Use the Internet Lab* 508-509 **Teacher Wraparound Edition:** A 509; AIL 508; CC 489; CD 489; DI 487, 490, 502; DIS 506; IL 490; R 493; SCB 484E-F
E2.4B	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.	**Student Edition:** 492-493, 497-500, 535-539 *Integrate Environment* 667 *Science and Society* 678, 778 **Teacher Wraparound Edition:** ACT 492, 538; LD 537
	STANDARD E3: THE SOLID EARTH *Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.*	
	E3.p1 Landforms and Soils *(prerequisite)* Landforms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruptions, and deposition of sediments transported in rivers, streams, and lakes through watersheds. Destructive forces include weathering and erosion. The weathering of rocks and decomposed organic matter result in the formation of soils. *(prerequisite)*	
E3.p1A	Explain the origin of Michigan landforms. Describe and identify surface features using maps and satellite images. *(prerequisite)*	**Student Edition:** 654-662 **Teacher Wraparound Edition:** ACT 655; CC 655; DIS 658

STANDARDS	PAGE REFERENCES
E3.p1B Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. *(prerequisite)*	**Student Edition:** 565-566, 646-652 *MiniLab* 647 *National Geographic* 666 *Science Online* 566 **Teacher Wraparound Edition:** M 649; PR 566, 651; QD 565; TFYI 566; V 666; VL 655
E3.p1C Describe how coastal features are formed by wave erosion and deposition. *(prerequisite)*	**Student Edition:** 660-661, 683 #19 **Teacher Wraparound Edition:** DI 292; DIS 660; RS 660
E3.p2 Rocks and Minerals *(prerequisite)* Igneous, metamorphic, and sedimentary rocks are constantly forming and changing through various processes. As they do so, elements move through the geosphere. In addition to other geologic features, rocks and minerals are indicators of geologic and environmental conditions that existed in the past. *(prerequisite)*	
E3.p3 Basic Plate Tectonics *(prerequisite)* Early evidence for the movement of continents was based on the similarities of coastlines, geology, faunal distributions, and paleoclimatelogical data across the Atlantic and Indian Oceans. In the 1960s, additional evidence from marine geophysical surveys, seismology, volcanology, and paleomagnetism resulted in the development of the theory of plate tectonics. *(prerequisite)*	
E3.1 Advanced Rock Cycle Igneous, metamorphic, and sedimentary rocks are indicators of geologic and environmental conditions and processes that existed in the past. These include cooling and crystallization, weathering and erosion, sedimentation and lithification, and metamorphism. In some way, all of these processes are influenced by plate tectonics, and some are influenced by climate.	
E3.1A Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another.	**Student Edition:** 617-623, 624-629, 630-635 *Applying Math* 621 *Lab* 636-637 *MiniLab* 628 *Science Online* 622 **Teacher Wraparound Edition:** CFU 623, 629; LD 634; QD 619, 621, 625; R 623; SCB 606E-F

STANDARDS		PAGE REFERENCES
E3.1B	Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks.	**Student Edition:** 373-375, 617-623, 630-635 **Teacher Wraparound Edition:** DIS 634; IM 618; SCB 352F; SJ 622; TFYI 632, 634; VL 631
	E3.2 Interior of the Earth The Earth can also be subdivided into concentric layers based on their physical characteristics: (lithosphere, asthenosphere, lower mantle, outer core, and inner core). The crust and upper mantle compose the rigid lithosphere (plates) that moves over a "softer" asthenosphere (part of the upper mantle). The magnetic field of the Earth is generated in the outer core. The interior of the Earth cannot be directly sampled and must be modeled using data from seismology.	
E3.2A	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.	**Student Edition:** 188, 370-372, 385 #5, 427 **Teacher Wraparound Edition:** ACT 371; CFU 372; FF 432; QD 371; SCB 184E, 352F
E3.2B	Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (**P**) and secondary (**S**) seismic wave arrivals.	**Student Edition:** 370-372 *Science Online* 293 **Teacher Wraparound Edition:** DIS 371; PR 372; R 372
E3.2C	Describe the differences between oceanic and continental crust (including density, age, composition).	**Student Edition:** 358-361, 608-609, 614 **Teacher Wraparound Edition:** CFU 361; R 361
	E3.3 Plate Tectonics Theory The Earth's crust and upper mantle make up the lithosphere, which is broken into large mobile pieces called tectonic plates. The plates move at velocities in units of centimeters per year as measured using the global positioning system (GPS). Motion histories are determined with calculations that relate rate, time, and distance of offset geologic features. Oceanic plates are created at mid-ocean ridges by magmatic activity and cooled until they sink back into the Earth at subduction zones. At some localities, plates slide by each other. Mountain belts are formed both by continental collision and as a result of subduction. The outward flow of heat from Earth's interior provides the driving energy for plate tectonics.	
E3.3A	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.	**Student Edition:** 354-361, 362-364, 373-378 *Science Online* 82 **Teacher Wraparound Edition:** A 361; PR 360; RS 360; SCB 352E; VL 356

STANDARDS		PAGE REFERENCES
E3.3B	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.	**Student Edition:** 358-361, 387 #14 **Teacher Wraparound Edition:** QD 360; TFYI 82, 360
E3.3C	Describe the motion history of geologic features (e.g., plates, Hawaii) using equations relating rate, time, and distance.	**Student Edition:** 358-361, 387 #6 *Applying Math* 357 *Lab* 379 **Teacher Wraparound Edition:** ACT 376; UP 251
	E3.4 Earthquakes and Volcanoes Plate motions result in potentially catastrophic events (earthquakes, volcanoes, tsunamis, mass wasting) that affect humanity. The intensity of volcanic eruptions is controlled by the chemistry and properties of the magma. Earthquakes are the result of abrupt movements of the Earth. They generate energy in the form of body and surface waves.	
E3.4A	Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries.	**Student Edition:** 358-360, 362-364, 373-378 *Science Online* 374 **Teacher Wraparound Edition:** A 293; CC 377; CFU 378
E3.4B	Describe how the sizes of earthquakes and volcanoes are measured or characterized.	**Student Edition:** 364-369, 375-378, 385 #15 *Lab* 380-381 **Teacher Wraparound Edition:** IL 367; PR 377
E3.4C	Describe the effects of earthquakes and volcanic eruptions on humans.	**Student Edition:** 293, 362-369 *Integrate Social Studies* 297 *Science Online* 359, 376 **Teacher Wraparound Edition:** CC 130; DIS 375; IES 293; PR 293, 369; SJ 374; UP 251

STANDARDS		PAGE REFERENCES
	STANDARD E4: THE FLUID EARTH *Students explain how the ocean and atmosphere move and transfer energy around the planet. They also explain how these movements affect climate and weather and how severe weather impacts society. Students explain how long term climatic changes (glaciers) have shaped the Michigan landscape. They also explain features and processes related to surface and ground-water and describe the sustainability of systems in terms of water quality and quantity.*	
	E4.p1 Water Cycle *(prerequisite)* Water circulates through the crust and atmosphere and in oceans, rivers, glaciers, and ice caps and connects all of the Earth systems. Groundwater is a significant reservoir and source of freshwater on Earth. The recharge and movement of groundwater depends on porosity, permeability, and the shape of the water table. The movement of groundwater occurs over a long period time. Groundwater and surface water are often interconnected. *(prerequisite)*	
	E4.p2 Weather and the Atmosphere *(prerequisite)* The atmosphere is divided into layers defined by temperature. Clouds are indicators of weather. *(prerequisite)*	
	E4.p3 Glaciers *(prerequisite)* Glaciers are large bodies of ice that move under the influence of gravity. They form part of both the rock and water cycles. Glaciers and ice sheets have shaped the landscape of the Great Lakes region. Areas that have been occupied by ice sheets are depressed. When the ice sheet is removed, the region rebounds (see also climate change). *(prerequisite)*	
	E4.1 Hydrogeology Fresh water moves over time between the atmosphere, hydrosphere (surface water, wetlands, rivers, and glaciers), and geosphere (groundwater). Water resources are both critical to and greatly impacted by humans. Changes in water systems will impact quality, quantity, and movement of water. Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.	
E4.1A	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).	**Student Edition:** 655-657, 663-668 *Applying Math* 665 **Teacher Wraparound Edition:** QD 657; VL 664
E4.1B	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.	**Student Edition:** 663-668, 681 #21 *Science and Society* 678 **Teacher Wraparound Edition:** DI 666; LD 665; PR 668

STANDARDS	PAGE REFERENCES
E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	**Student Edition:** 663-668, 681 #22 *Integrate Environment* 48 *Science and Society* 678, 778 **Teacher Wraparound Edition:** A 668; CB 678; R 668; SCB 644F; VL 48
E4.2 Oceans and Climate Energy from the sun and the rotation of the Earth control global atmospheric circulation. Oceans redistribute matter and energy around the Earth through currents, waves, and interaction with other Earth systems. Ocean currents are controlled by prevailing winds, changes in water density, ocean topography, and the shape and location of landmasses. Oceans and large lakes (e.g., Great Lakes) have a major effect on climate and weather because they are a source of moisture and a large reservoir of heat. Interactions between oceanic circulation and the atmosphere can affect regional climates throughout the world.	
E4.2A 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.	**Student Edition:** 660
E4.2B 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, and the ocean as a major CO_2 reservoir.	**Student Edition:** 532-533, 539 *Integrate Earth Science* 258 **Teacher Wraparound Edition:** AIL 278; DIS 532
E4.3 Severe Weather Tornadoes, hurricanes, blizzards, and thunderstorms are severe weather phenomena that impact society and ecosystems. Hazards include downbursts (wind shear), strong winds, hail, lightning, heavy rain, and flooding. The movement of air in the atmosphere is due to differences in air density resulting from variations in temperature. Many weather conditions can be explained by fronts that occur when air masses meet.	
E4.3A Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought).	**Student Edition:** 527-528 *National Geographic* 397 **Teacher Wraparound Edition:** AIL 278; DI 527; IM 527
E4.3B Describe the damage resulting from, and the social impact of thunderstorms, tornadoes, hurricanes, and floods.	**Student Edition:** 539, 545 #31 *Science Online* 528

STANDARDS		PAGE REFERENCES
E4.3C	Describe severe weather and flood safety and mitigation.	**Student Edition:** 398 *Integrate Earth Science* 11 *Science Online* 396 **Teacher Wraparound Edition:** A 528
E4.3D	Describe the seasonal variations in severe weather.	**Student Edition:** 530, 533
E4.3E	Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).	**Student Edition:** 526-528 **Teacher Wraparound Edition:** PR 528; QD 527
E4.3F	Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation.	**Student Edition:** 526-528, 532-533 **Teacher Wraparound Edition:** ACT 526; AIL 278; QD 533; SJ 526; TFYI 526

STANDARD E5: THE EARTH IN SPACE AND TIME

Students explain theories about how the Earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

E5.p1 Sky Observations *(prerequisite)*

Common sky observations (such as lunar phases) can be explained by the motion of solar system objects in regular and predictable patterns. Our galaxy, observable as the Milky Way, is composed of billions of stars, some of which have planetary systems. Seasons are a result of the tilt of the rotation axis of the Earth. The motions of the moon and sun affect the phases of the moon and ocean tides. *(prerequisite)*

STANDARDS		PAGE REFERENCES
	E5.1 The Earth in Space Scientific evidence indicates the universe is orderly in structure, finite, and contains all matter and energy. Information from the entire light spectrum tells us about the composition and motion of objects in the universe. Early in the history of the universe, matter clumped together by gravitational attraction to form stars and galaxies. According to the Big Bang theory, the universe has been continually expanding at an increasing rate since its formation about 13.7 billion years ago.	
E5.1A	Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.	**Student Edition:** 823-829, 831-835, 836-839 *Integrate Astronomy* 74, 324 *Lab* 830 *Launch Lab* 217, 817 *Model and Invent Lab* 840-841 *National Geographic* 826 *Science and History* 120 *Science Online* 834 **Teacher Wraparound Edition:** CFU 835; IL 832; R 835
	E5.2 The Sun Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. Solar energy is responsible for life processes and weather as well as phenomena on Earth. These and other processes in stars have led to the formation of all the other chemical elements.	
E5.2A	Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).	**Student Edition:** 188, 828-829 **Teacher Wraparound Edition:** LD 827
E5.2B	Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances.	**Student Edition:** 188, 215 #12, 828-829, 845 #27 *Applying Math* 845 **Teacher Wraparound Edition:** SCB 816E
E5.2C	Describe how nuclear fusion produces energy in the Sun.	**Student Edition:** 500, 803 **Teacher Wraparound Edition:** CB 280; CFU 500
E5.2D	Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	**Student Edition:** 596

STANDARDS		PAGE REFERENCES
	E5.2x Stellar Evolution Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. These and other processes in stars have led to the formation of all the other chemical elements. There is a wide range of stellar objects of different sizes and temperatures. Stars have varying life histories based on these parameters.	
	E5.3 Earth History and Geologic Time The solar system formed from a nebular cloud of dust and gas 4.6 Ga (billion years ago). The Earth has changed through time and has been affected by both catastrophic (e.g., earthquakes, meteorite impacts, volcanoes) and gradual geologic events (e.g., plate movements, mountain building) as well as the effects of biological evolution (formation of an oxygen atmosphere). Geologic time can be determined through both relative and absolute dating.	
E5.3A	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).	**Student Edition:** 218-222 **Teacher Wraparound Edition:** A 222; PR 222; R 222; SCB 216E; VL 221
E5.3B	Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.	**Student Edition:** 672-673, 681 #18, 791-795 *Applying Math* 586, 681 *Integrate Earth Science* 496 **Teacher Wraparound Edition:** RS 670; UAA 794
E5.3C	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.	**Student Edition:** 672 *Launch Lab* 645 **Teacher Wraparound Edition:** CFU 675; R 675; SJ 670; VL 672
E5.3D	Describe how index fossils can be used to determine time sequence.	**Student Edition:** 671 *Integrate Earth Science* 496 **Teacher Wraparound Edition:** RS 670

STANDARDS		PAGE REFERENCES
E5.3x Geologic Dating Early methods of determining geologic time, such as the use of index fossils and stratigraphic principles, allowed for the relative dating of geological events. However, absolute dating was impossible until the discovery that certain radioactive isotopes in rocks have known decay rates, making it possible to determine how many years ago a given mineral or rock formed. Different kinds of radiometric dating techniques exist. Technique selection depends on the composition of the material to be dated, the age of the material, and the type of geologic event that affected the material.		
E5.4 Climate Change Atmospheric gases trap solar energy that has been reradiated from the Earth's surface (the greenhouse effect). The Earth's climate has changed both gradually and catastrophically over geological and historical time frames due to complex interactions between many natural variables and events. The concentration of greenhouse gases (especially carbon dioxide) has increased due to human industrialization, which has contributed to a rise in average global atmospheric temperatures and changes in the biosphere, atmosphere, and hydrosphere. Climates of the past are researched, usually using indirect indicators, to better understand and predict climate change.		
E5.4A	Explain the natural mechanism of the greenhouse effect, including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone).	**Student Edition:** 520 **Teacher Wraparound Edition:** CFU 539; DIS 520
E5.4B	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).	**Student Edition:** 535-536 *Integrate History* 377, 536 *Science and History* 382 **Teacher Wraparound Edition:** CB 382; R 539
E5.4C	Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature over the past 150 years.	**Student Edition:** 492, 536-539 *Applying Math* 537 *Lab* 51 **Teacher Wraparound Edition:** FF 538; LD 537
E5.4D	Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere).	**Student Edition:** 536-539, 545 #27 **Teacher Wraparound Edition:** A 539; PR 539; SCB 516F

STANDARDS		PAGE REFERENCES
CHEMISTRY		
STANDARD C1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS *Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.*		
C1.1 Scientific Inquiry Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.		
C1.1A	Generate new questions that can be investigated in the laboratory or field.	**Student Edition:** 6-10, 12, 38-39, 42-45, 54-57 *Design Your Own LAB* 88-89 *LAB* 27, 51 *Model and Invent LAB* 176-177 *Science Skill Handbook* 850 **Teacher Wraparound Edition:** D 39; IM 43; LD 54; PR 50
C1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	**Student Edition:** 10, 14-21 *Accidents in Science* 210 *Design Your Own LAB* 28-29, 144-145, 568-569 *Launch Lab* 3, 185, 785 *Science Skill Handbook* 850-858 **Teacher Wraparound Edition:** FF 8; SJ 11

STANDARDS		PAGE REFERENCES
C1.1C	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).	**Student Edition:** 14-21 *Design Your Own LAB* 28-29 *LAB* 27, 196, 300, 775 *Launch Lab* 69, 645 *MiniLAB* 19, 71 *Model and Invent LAB* 176-177 *National Geographic* 18 **Teacher Wraparound Edition:** LD 54; QD 17
C1.1D	Identify patterns in data and relate them to theoretical models.	**Student Edition:** 11, 194, 199-202, 492-493, 588-595 *LAB* 597, 830 *National Geographic* 292, 548-549 *Science and History* 600 **Teacher Wraparound Edition:** CC 39; DI 10; IL 202
C1.1E	Describe a reason for a given conclusion using evidence from an investigation.	**Student Edition:** 6-10, 12-13 *Design Your Own LAB* 414-415, 568-569 *LAB* 196, 406 *Model and Invent LAB* 840-841 *Science and History* 146, 478 *Science and Society* 778 *Science Skill Handbook* 858 **Teacher Wraparound Edition:** DI 553; FYI 404; QD 10

STANDARDS		PAGE REFERENCES
	C1.2 Scientific Reflection and Social Implications The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.	
C1.2A	Critique whether or not specific questions can be answered through scientific investigations.	**Student Edition:** 6-10, 38-45, 46-50 *MiniLAB* 40 **Teacher Wraparound Edition:** CC 10; D 39; DI 7
C1.2B	Identify and critique arguments about personal or societal issues based on scientific evidence.	**Student Edition:** 42-45, 46-50 *LAB* 51 *Model and Invent LAB* 58-59 **Teacher Wraparound Edition:** A 48; DI 44; PR 50
C1.2C	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	**Student Edition:** 8, 14-21 *Science Skill Handbook* 850 **Teacher Wraparound Edition:** CD 8
C1.2D	Evaluate scientific explanations in a peer review process or discussion format.	**Student Edition:** 10, 46-49 *Design Your Own LAB* 88-89 *LAB* 51, 87, 112, 118-119, 134 *Model and Invent LAB* 58-59 **Teacher Wraparound Edition:** A 48; CYD 59
C1.2E	Evaluate the future career and occupational prospects of science fields.	**Student Edition:** *Applying Science* 49 *Integrate Career* 56, 408, 440, 472, 592, 753 **Teacher Wraparound Edition:** IC 56, 408, 440, 472, 592, 753; IE 139; R 57

STANDARDS		PAGE REFERENCES
	STANDARD C2: FORMS OF ENERGY *Students recognize the many forms of energy and understand that energy is central to predicting and explaining how and why chemical reactions occur. The chemical topics of bonding, gas behavior, kinetics, enthalpy, entropy, free energy, and nuclear stability are addressed in this standard.* *Chemistry students relate temperature to the average kinetic energy of the molecules and use the kinetic molecular theory to describe and explain the behavior of gases and the rates of chemical reactions. They understand nuclear stability in terms of reaching a state of minimum potential energy.*	
	P2.p1 Potential Energy *(prerequisite)* Three forms of potential energy are gravitational, elastic, and chemical. Objects can have elastic potential energy due to their compression or chemical potential energy due to the arrangement of the atoms. *(prerequisite)*	
	C2.1x Chemical Potential Energy Potential energy is stored whenever work must be done to change the distance between two objects. The attraction between the two objects may be gravitational, electrostatic, magnetic, or strong force. Chemical potential energy is the result of electrostatic attractions between atoms.	
	C2.2 Molecules in Motion Molecules that compose matter are in constant motion (translational, rotational, vibrational). Energy may be transferred from one object to another during collisions between molecules.	
C2.2A	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.	**Student Edition:** 266-267 **Teacher Wraparound Edition:** AS 279
C2.2B	Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.	**Student Edition:** 260-261 *MiniLAB* 262 **Teacher Wraparound Edition:** D 264; R 265
	C2.2x Molecular Entropy As temperature increases, the average kinetic energy and the entropy of the molecules in a sample increases.	
	C2.3x Breaking Chemical Bonds For molecules to react, they must collide with enough energy (activation energy) to break old chemical bonds before their atoms can be rearranged to form new substances.	

STANDARDS	PAGE REFERENCES
C2.4x Electron Movement For each element, the arrangement of electrons surrounding the nucleus is unique. These electrons are found in different energy levels and can only move from a lower energy level (closer to nucleus) to a higher energy level (farther from nucleus) by absorbing energy in discrete packets. The energy content of the packets is directly proportional to the frequency of the radiation. These electron transitions will produce unique absorption spectra for each element. When the electron returns from an excited (high energy state) to a lower energy state, energy is emitted in only certain wavelengths of light, producing an emission spectra.	
C2.5x Nuclear Stability Nuclear stability is related to a decrease in potential energy when the nucleus forms from protons and neutrons. If the neutron/proton ratio is unstable, the element will undergo radioactive decay. The rate of decay is characteristic of each isotope; the time for half the parent nuclei to decay is called the half-life. Comparison of the parent/daughter nuclei can be used to determine the age of a sample. Heavier elements are formed from the fusion of lighter elements in the stars.	
STANDARD C3: ENERGY TRANSFER AND CONSERVATION *Students apply the First and Second Laws of Thermodynamics to explain and predict most chemical phenomena.* *Chemistry students use the term enthalpy to describe the transfer of energy between reactants and products in simple calorimetry experiments performed in class and will recognize Hess's Law as an application of the conservation of energy.* *Students understand the tremendous energy released in nuclear reactions is a result of small amounts of matter being converted to energy.*	
P3.p1 Conservation of Energy *(prerequisite)* When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. *(prerequisite)*	
C3.1x Hess's Law For chemical reactions where the state and amounts of reactants and products are known, the amount of energy transferred will be the same regardless of the chemical pathway. This relationship is called Hess's law.	
P3.p2 Energy Transfer *(prerequisite)* Nuclear reactions take place in the sun. In plants, light from the sun is transferred to oxygen and carbon compounds, which, in combination, have chemical potential energy (photosynthesis). *(prerequisite)*	
C3.2x Enthalpy Chemical reactions involve breaking bonds in reactants (endothermic) and forming new bonds in the products (exothermic). The enthalpy change for a chemical reaction will depend on the relative strengths of the bonds in the reactants and products.	

STANDARDS		PAGE REFERENCES
	C3.3 Heating Impacts Heating increases the kinetic (translational, rotational, and vibrational) energy of the atoms composing elements and the molecules or ions composing compounds. As the kinetic (translational) energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a sample of a crystalline solid increases the kinetic (vibrational) energy of the atoms, molecules, or ions. When the kinetic (vibrational) energy becomes great enough, the crystalline structure breaks down, and the solid melts.	
C3.3A	Describe how heat is conducted in a solid.	**Student Edition:** 266-267 **Teacher Wraparound Edition:** PR 270; VL 267
C3.3B	Describe melting on a molecular level.	**Student Edition:** 261-263 *MiniLAB* 262 **Teacher Wraparound Edition:** UA 262
	C3.3x Bond Energy Chemical bonds possess potential (vibrational and rotational) energy.	
	C3.4 Endothermic and Exothermic Reactions Chemical interactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).	
C3.4A	Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory.	**Student Edition:** 735-738 **Teacher Wraparound Edition:** LD 736; R 740; USW 735
C3.4B	Explain why chemical reactions will either release or absorb energy.	**Student Edition:** 734-735 **Teacher Wraparound Edition:** D 739
	C3.4x Enthalpy and Entropy All chemical reactions involve rearrangement of the atoms. In an exothermic reaction, the products have less energy than the reactants. There are two natural driving forces: (1) toward minimum energy (enthalpy) and (2) toward maximum disorder (entropy).	
	C3.5x Mass Defect Nuclear reactions involve energy changes many times the magnitude of chemical changes. In chemical reactions matter is conserved, but in nuclear reactions a small loss in mass (mass defect) will account for the tremendous release of energy. The energy released in nuclear reactions can be calculated from the mass defect using $E = mc^2$.	

STANDARDS	PAGE REFERENCES
STANDARD C4: PROPERTIES OF MATTER *Compounds, elements, and mixtures are categories used to organize matter. Students organize materials into these categories based on their chemical and physical behavior. Students understand the structure of the atom to make predictions about the physical and chemical properties of various elements and the types of compounds those elements will form. An understanding of the organization the Periodic Table in terms of the outer electron configuration is one of the most important tools for the chemist and student to use in prediction and explanation of the structure and behavior of atoms.*	
P4.p1 Kinetic Molecular Theory *(prerequisite)* Properties of solids, liquids, and gases are explained by a model of matter that is composed of tiny particles in motion. *(prerequisite)*	
P4.p1A For a substance that can exist in all three phases, describe the relative motion of the particles in each of the phases. *(prerequisite)*	**Student Edition:** 260-261 **Teacher Wraparound Edition:** FYI 263; LD 261; UA 262
P4.p1B For a substance that can exist in all three phases, make a drawing that shows the arrangement and relative spacing of the particles in each of the phases. *(prerequisite)*	**Student Edition:** 260-261 **Teacher Wraparound Edition:** LD 261; UA 262
P4.p1C For a simple compound, present a drawing that shows the number of particles in the system does not change as a result of a phase change. *(prerequisite)*	**Student Edition:** 562-563 *MiniLAB* 262 **Teacher Wraparound Edition:** 550F; IM 566; ML 262
P4.p2 Elements, Compounds, and Mixtures *(prerequisite)* Elements are a class of substances composed of a single kind of atom. Compounds are composed of two or more different elements chemically combined. Mixtures are composed of two or more different elements and/or compounds physically combined. Each element and compound has physical and chemical properties, such as boiling point, density, color, and conductivity, which are independent of the amount of the sample. (prerequisite)	
C4.1x Molecular and Empirical Formulae Compounds have a fixed percent elemental composition. For a compound, the empirical formula can be calculated from the percent composition or the mass of each element. To determine the molecular formula from the empirical formula, the molar mass of the substance must also be known.	

STANDARDS		PAGE REFERENCES
	C4.2 Nomenclature All compounds have unique names that are determined systematically.	
C4.2A	Name simple binary compounds using their formulae.	**Student Edition:** 703-706, 708-709 *Applying Science* 706 **Teacher Wraparound Edition:** IM 704; TPK 703
C4.2B	Given the name, write the formula of simple binary compounds.	**Student Edition:** 705 *Applying Math* 705 **Teacher Wraparound Edition:** A 705
	C4.2x Nomenclature All molecular and ionic compounds have unique names that are determined systematically.	
	C4.3 Properties of Substances Differences in the physical and chemical properties of substances are explained by the arrangement of the atoms, ions, or molecules of the substances and by the strength of the forces of attraction between the atoms, ions, or molecules.	
C4.3A	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.	**Student Edition:** 260-262 **Teacher Wraparound Edition:** CU 265
C4.3B	Recognize that solids have a more ordered, regular arrangement of their particles than liquids and that liquids are more ordered than gases.	**Student Edition:** 260-262 **Teacher Wraparound Edition:** UA 262
	C4.3x Solids Solids can be classified as metallic, ionic, covalent, or network covalent. These different types of solids have different properties that depend on the particles and forces found in the solid.	
	C4.4x Molecular Polarity The forces between molecules depend on the net polarity of the molecule as determined by shape of the molecule and the polarity of the bonds.	
	C4.5x Ideal Gas Law The forces in gases are explained by the ideal gas law.	
	C4.6x Moles The mole is the standard unit for counting atomic and molecular particles in terms of common mass units.	

STANDARDS		PAGE REFERENCES
	C4.7x Solutions The physical properties of a solution are determined by the concentration of solute.	
	C4.8 Atomic Structure Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.	
C4.8A	Identify the location, relative mass, and charge for electrons, protons, and neutrons.	**Student Edition:** 579, 584-585 *National Geographic* 582 **Teacher Wraparound Edition:** PR 583
C4.8B	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.	**Student Edition:** 583 *National Geographic* 582 **Teacher Wraparound Edition:** A 582
C4.8C	Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.	**Student Edition:** 104, 579, 787-788 *MiniLAB* 789 **Teacher Wraparound Edition:** A 582; MM 787
C4.8D	Give the number of electrons and protons present if the fluoride ion has a -1 charge.	**Student Edition:** 591 **Teacher Wraparound Edition:** PR 583; R 692
	C4.8x Electron Configuration Electrons are arranged in main energy levels with sublevels that specify particular shapes and geometry. Orbitals represent a region of space in which an electron may be found with a high level of probability. Each defined orbital can hold two electrons, each with a specific spin orientation. The specific assignment of an electron to an orbital is determined by a set of 4 quantum numbers. Each element and, therefore, each position in the periodic table is defined by a unique set of quantum numbers.	

STANDARDS		PAGE REFERENCES
	C4.9 Periodic Table In the periodic table, elements are arranged in order of increasing number of protons (called the atomic number). Vertical groups in the periodic table (families) have similar physical and chemical properties due to the same outer electron structures.	
C4.9A	Identify elements with similar chemical and physical properties using the periodic table.	**Student Edition:** 590-591, 595 **Teacher Wraparound Edition:** D 593
	C4.9x Electron Energy Levels The rows in the periodic table represent the main electron energy levels of the atom. Within each main energy level are sublevels that represent an orbital shape and orientation.	
	C4.10 Neutral Atoms, Ions, and Isotopes A neutral atom of any element will contain the same number of protons and electrons. Ions are charged particles with an unequal number of protons and electrons. Isotopes are atoms of the same element with different numbers of neutrons and essentially the same chemical and physical properties.	
C4.10A	List the number of protons, neutrons, and electrons for any given ion or isotope.	**Student Edition:** 584-587, 590-591 **Teacher Wraparound Edition:** D 585; IM 586; VL 586
C4.10B	Recognize that an element always contains the same number of protons.	**Student Edition:** 585, 590-591, 786, 789 **Teacher Wraparound Edition:** R 790
	C4.10x Average Atomic Mass The atomic mass listed on the periodic table is an average mass for all the different isotopes that exist, taking into account the percent and mass of each different isotope.	
	STANDARD C5: CHANGES IN MATTER *Students will analyze a chemical change phenomenon from the point of view of what is the same and what is not the same.*	
	P5.p1 Conservation of Matter *(prerequisite)* Changes of state are explained by a model of matter composed of tiny particles that are in motion. When substances undergo changes of state, neither atoms nor molecules themselves are changed in structure. Mass is conserved when substances undergo changes of state. *(prerequisite)*	
	C5.r1x Rates of Reactions *(recommended)* The rate of a chemical reaction will depend upon (1) concentration of reacting species, (2) temperature of reaction, (3) pressure if reactants are gases, and (4) nature of the reactants. A model of matter composed of tiny particles that are in constant motion is used to explain rates of chemical reactions. *(recommended)*	

STANDARDS		PAGE REFERENCES
	C5.2 Chemical Changes Chemical changes can occur when two substances, elements, or compounds interact and produce one or more different substances whose physical and chemical properties are different from the interacting substances. When substances undergo chemical change, the number of atoms in the reactants is the same as the number of atoms in the products. This can be shown through simple balancing of chemical equations. Mass is conserved when substances undergo chemical change. The total mass of the interacting substances (reactants) is the same as the total mass of the substances produced (products).	
C5.2A	Balance simple chemical equations applying the conservation of matter.	**Student Edition:** 721-722, 724-725, 726-729 **Teacher Wraparound Edition:** D 727; R 725
C5.2B	Distinguish between chemical and physical changes in terms of the properties of the reactants and products.	**Student Edition:** 562-566 **Teacher Wraparound Edition:** CU 567; LD 562; QD 565
C5.2C	Draw pictures to distinguish the relationships between atoms in physical and chemical changes.	**Student Edition:** 260-263, 724-725, 736, 738, 768 **Teacher Wraparound Edition:** VL 724
	C5.2x Balancing Equations A balanced chemical equation will allow one to predict the amount of product formed.	
	C5.3x Equilibrium Most chemical reactions reach a state of dynamic equilibrium where the rates of the forward and reverse reactions are equal.	
	C5.4 Phase Change/Diagrams Changes of state require a transfer of energy. Water has unusually high-energy changes associated with its changes of state.	
C5.4A	Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.	**Student Edition:** 257-259 **Teacher Wraparound Edition:** QD 258
C5.4B	Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.	**Student Edition:** 262-263 **Teacher Wraparound Edition:** RS 263
	C5.4x Changes of State All changes of state require energy. Changes in state that require energy involve breaking forces holding the particles together. The amount of energy will depend on the type of forces.	

STANDARDS		PAGE REFERENCES
	C5.5 Chemical Bonds — Trends An atom's electron configuration, particularly of the outermost electrons, determines how the atom can interact with other atoms. The interactions between atoms that hold them together in molecules or between oppositely charged ions are called chemical bonds.	
C5.5A	Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.	**Student Edition:** 696-698 **Teacher Wraparound Edition:** A 696, 697; AS 702; DI 698
C5.4B	Predict the formula for binary compounds of main group elements.	**Student Edition:** 703-706 *Applying Math* 705 **Teacher Wraparound Edition:** IM 704
	C5.5x Chemical Bonds Chemical bonds can be classified as ionic, covalent, and metallic. The properties of a compound depend on the types of bonds holding the atoms together.	
	C5.6x Reduction/Oxidation Reactions Chemical reactions are classified according to the fundamental molecular or submolecular changes that occur. Reactions that involve electron transfer are known as oxidation/reduction (or "redox").	
	C5.7 Acids and Bases Acids and bases are important classes of chemicals that are recognized by easily observed properties in the laboratory. Acids and bases will neutralize each other. Acid formulas usually begin with hydrogen, and base formulas are a metal with a hydroxide ion. As the pH decreases, a solution becomes more acidic. A difference of one pH unit is a factor of 10 in hydrogen ion concentration.	
C5.7A	Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.	**Student Edition:** 764-767 **Teacher Wraparound Edition:** A 765; FYI 766
C5.7B	Predict products of an acid-base neutralization.	**Student Edition:** 769 **Teacher Wraparound Edition:** AS 770; DI 769
C5.7C	Describe tests that can be used to distinguish an acid from a base.	**Student Edition:** 773 *LAB* 775 **Teacher Wraparound Edition:** QD 773; R 770

STANDARDS		PAGE REFERENCES
C5.7D	Classify various solutions as acidic or basic, given their pH.	**Student Edition:** 768-770, 773 *Integrate Life Science* 774 **Teacher Wraparound Edition:** D 773; QD 766
C5.7E	Explain why lakes with limestone or calcium carbonate experience less adverse effects from acid rain than lakes with granite beds.	**Student Edition:** *Science and Society* 778 **Teacher Wraparound Edition:** AS 774
	C5.7x Brønsted-Lowry Chemical reactions are classified according to the fundamental molecular or submolecular changes that occur. Reactions that involve proton transfer are known as acid/base reactions.	
	C5.8 Carbon Chemistry The chemistry of carbon is important. Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.	
C5.8A	Draw structural formulas for up to ten carbon chains of simple hydrocarbons.	**Student Edition:** 489, 490 Discussion in this text is limited to hydrocarbon chains of one to four carbons.
C5.8B	Draw isomers for simple hydrocarbons.	Hydrocarbon isomerization can be covered during teacher/class discussion.
C5.8C	Recognize that proteins, starches, and other large biological molecules are polymers.	Biological polymers and polymers in general can be covered during teacher/class discussion.