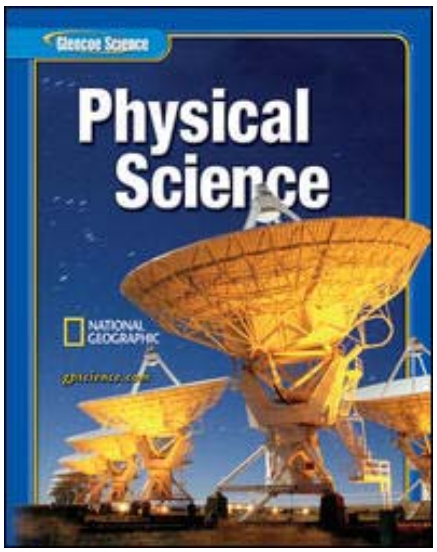
Curriculum Framework
Science Content Benchmarks
Middle School



Physical Science

STANDARDS	PAGE REFERENCES
I. Constructing New Scientific Knowledge (C) I.1	
All students will ask questions that help them learn about the world:	
1. Generate scientific questions about the world based on observation. *Key concepts:* Scientific questions can be answered by gathering and analyzing evidence about the world. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	**Student Edition:** 6 *Design Your Own LAB* 58-59, 214-215, 246-247, 344-345, 406-407, 716-717 *LAB* 89, 180-181, 466-467, 622-623, 777 *Launch LAB* 5 *Model and Invent LAB* 148-149, 558-559 *Science Skill Handbook* 788-796 *Use the Internet LAB* 278-279, 374-375, 526-527 **Teacher Wraparound Edition:** AIL 374, 466; QD 10 **Teacher Resources:** *Chapter Resources* The Nature of Science 27, 33 *Chapter Resources* Waves 13-15

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

STANDARDS	PAGE REFERENCES
All students will design and conduct investigations using appropriate methodology and technology:	
2. Design and conduct scientific investigations. *Key concepts:* The process of scientific investigations—test, fair test, hypothesis, theory, evidence, observations, measurements, data, conclusion. Forms for recording and reporting data—tables, graphs, journals. See C-I.1 m.3 (tools). *Real-world contexts:* Any in the sections on Using Scientific Knowledge; also, recognizing differences between observations and inferences; recording observations and measurements of everyday phenomena.	**Student Edition:** 6-13 *Design Your Own LAB* 58-59, 214-215, 246-247, 344-345, 406-407, 716-717 *LAB* 90-91, 180-181, 466-467, 622-623, 686-687 *Math Skill Handbook* 830-831 *Model and Invent LAB* 148-149 *Science Skill Handbook* 788-796 *Technology Skill Handbook* 813-816 **Teacher Wraparound Edition:** A 9; AIL 246, 374 **Teacher Resources:** *Chapter Resources* The Nature of Science 9-12, 13-15, 21, 27
3. Use tools and equipment appropriate to scientific investigations. *Tools:* various data collection tools suitable for this level, including computers. *Real-world contexts*: Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.	**Student Edition:** 17-19, 21 *Design Your Own LAB* 116-117, 214-215, 716-717 *LAB* 90-91, 180-181, 206, 312-313, 466-467, 622-623 *MiniLAB* 19, 25 *National Geographic* 20 *Science Skill Handbook* 793-794 *Technology Skill Handbook* 814-816 **Teacher Wraparound Edition:** A 18; TPK 22 **Teacher Resources:** *Chapter Resources* Electricity 9-10 *Chapter Resources* Forces 13-16 *Chapter Resources* Motion 9-11 *Chapter Resources* The Nature of Science 9-12

STANDARDS	PAGE REFERENCES
4. Use metric measurement devices to provide consistency in an investigation. *Key concepts:* Documentation—laboratory instructions. Measurement units—milliliters, liters, millimeter, centimeter, meter, gram. *Measurement tools:* Balancing devices, measuring tape, thermometer, graduated cylinder. *Real-world contexts:* Conducting investigations, following or altering laboratory instructions for mixing chemicals.	**Student Edition:** 14-21, 21 *Applying Math* 16 *Design Your Own LAB* 28-29, 116-117 *LAB* 27, 90-91, 496-497, 686-687, 778-779 *Math Skill Handbook* 827-829 *MinLAB* 19, 25 *Model and Invent LAB* 148-149 *National Geographic* 20 **Teacher Wraparound Edition:** AC 17, 18, 20; CU 21; D 16; IM 15; MM 16; QD 17; SJ 15; VL 17 **Teacher Resources:** *Chapter Resources* Electricity 11-14 *Chapter Resources* Motion 9-11 *Chapter Resources* The Nature of Science 9-12, 28, 31 *Chapter Resources* Thermal Energy 13-15 *Chapter Resources* Work and Machines 13-18
All students will learn from books and other sources of information:	
5. Use sources of information in support of scientific investigations. *Tools:* Periodicals, reference books, trade books, web sites, computer software; forms for presenting scientific information, such as figures, tables, graphs. See R-II.1 m.1 (evaluate strengths/weaknesses of claims). *Real-world contexts:* Libraries, projects where research is needed.	**Student Edition:** 8, 11, 22-26 *Math Skill Handbook* 830-831 *Reference Handbooks* 846-847 *Science Skill Handbook* 788-789 *Technology Skill Handbook* 814 *Use the Internet LAB* 278-279, 374-375, 526-527, 652-653 **Teacher Wraparound Edition:** A 11, 23; D 11; LD 25 **Teacher Resources:** *Chapter Resources* The Nature of Science 29, 31, 46, 47-48, 49

STANDARDS	PAGE REFERENCES
All students will communicate findings of investigations, using appropriate technology.	
6. Write and follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches. *Key concepts:* Purpose, procedure, observation, conclusion, data. *Real-world contexts:* Listing or creating the directions for completing a task, reporting on investigations.	**Student Edition:** 6-13 *Design Your Own LAB* 58-59, 246-247 *LAB* 90-91, 206, 423, 457, 466-467, 622-623 *Model and Invent LAB* 148-149, 558-559 *Science Skill Handbook* 789-791 **Teacher Resources:** *Chapter Resources* Chemical Reactions 13-16 *Chapter Resources* Electricity 11-14 *Chapter Resources* Energy 9-12 *Chapter Resources* Forces 13-16 *Chapter Resources* The Nature of Science 27, 33 *Chapter Resources* Waves 13-15 *Chapter Resources* Work and Machines 13-18
II. Reflecting on Scientific Knowledge (R) II.1	
All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge:	
1. Evaluate the strengths and weaknesses of claims, arguments, or data. *Key concepts:* Aspects of arguments such as data, evidence, sampling, alternate explanation, conclusion; inference, observation. *Real-world contexts:* Deciding between alternate explanations or plans for solving problems; evaluating advertising claims or cases made by interest groups; evaluating sources of references.	**Student Edition:** 8-10 *Science Skill Handbook* 792-793, 795-796 **Teacher Wraparound Edition:** AIL 28; CC 10; D 8, 23; DI 10, 23; IL 12; QD 10 **Teacher Resources:** *Chapter Resources* The Nature of Science 27
2. Describe limitations in personal knowledge. *Key concepts:* Recognizing degrees of confidence in ideas or knowledge from different sources, evaluating dates and sources of references. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	**Student Edition:** 10, 12 *Science Skill Handbook* 788 **Teacher Wraparound Edition:** DI 7; FF 10; SJ 11; VL 11

STANDARDS	PAGE REFERENCES
All students will show how science is related to other ways of knowing:	
3. Show how common themes of science, mathematics, and technology apply in real-world contexts. *Thematic ideas:* Systems-subsystems, feedback models, mathematical constancy, scale, conservation, structure, function, adaptation. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	**Student Edition:** *Applying Science* 228, 269, 744 *Design Your Own LAB* 58-59, 344-345 *LAB* 366, 484 *Model and Invent LAB* 148-149 *Use the Internet LAB* 278-279 **Teacher Wraparound Edition:** AIL 58, 180, 246, 278, 344, 496; CA 13 **Teacher Resources:** *Chapter Resources* The Nature of Science 27, 33-34
All students will show how science and technology affect our society:	
4. Describe the advantages and risks of new technologies. *Key concepts:* Risk, benefit, side effect, advantage, disadvantage. *Real-world contexts:* Technological systems for manufacturing, transportation, energy distribution, housing, medicine (such as cloning, genetic engineering).	**Student Edition:** 13, 261-263, 265-269, 271-276, 367-373, 394-396, 432-437, 554, 556 *Design Your Own LAB* 344-345 *Integrate Social Studies* 267 *LAB* 778-779 *National Geographic* 2-3, 397, 430, 555, 738, 769 *Science and History* 248 *Science and Society* 346, 440 *Use the Internet LAB* 652-653 **Teacher Wraparound Edition:** CC 265; D 273; DI 260, 268; IM 273; SJ 267; TFYI 12
5. Develop an awareness of and sensitivity to the natural world. *Key concepts:* Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world. *Real-world contexts:* Any in the sections on Using Scientific Knowledge appropriate to middle school.	**Student Edition:** 263, 268-269, 364, 648 *Integrate Environment* 364 *Science and History* 528 *Science and Society* 718 *Use the Internet LAB* 652-653 **Teacher Wraparound Edition:** A 268; AIL 652; CA 653; CC 364; II 718; IL 260

STANDARDS	PAGE REFERENCES
All students will show how people of diverse cultures have contributed to and influenced developments in science:	
6. Recognize the contributions made in science by cultures and individuals of diverse backgrounds. *Key concepts:* Cultural contributions to science, contributions made by people of diverse backgrounds. *Real-world contexts:* Biographies of minority and female scientists; histories of cultural contributions to science.	**Student Edition:** 54, 485, 486, 488, 492, 494, 509, 516-517, 551 *Integrate History* 9, 540 *National Geographic* 510 *Science and History* 92, 314, 376, 528, 560 *Science Online* 540 **Teacher Wraparound Edition:** CC 128, 134, 160, 233; CD 8, 84, 104, 139, 210, 226, 235, 370, 428, 538; DI 161; SJ 242; TFYI 297
III. Using Life Science Knowledge	
Cells (LC) III.1	
All students will apply an understanding of cells to the functioning of multicellular organisms, including how cells grow, develop and reproduce:	
1. Demonstrate evidence that all parts of living things are made of cells. *Key concepts:* Types of living things: plants, animals; parts of organisms: tissues, organs, organ systems; all functions of organisms are carried out by cells. See LC-III.1 m.2 for specific functions. Tools: Hand lens, microscope. *Real-world contexts:* Common plant or animal cells: Elodea leaf cells, onion skin cells, human cheek cells. Single-celled organisms: Paramecium.	See Glencoe's *Life Science* © 2005.
2. Explain why and how selected specialized cells are needed by plants and animals. *Key concepts:* Specialized functions of cells—reproduction, photosynthesis, transport, movement, disease-fighting. See LO m.4 (systems and processes functioning to provide/remove materials to/from cells). *Real-world contexts:* Specialized animal cells: red blood cells, white blood cells, muscle cells, bone cells, nerve cells, egg/sperm cells; specialized plant cells—root cells, leaf cells, stem cells.	See Glencoe's *Life Science* © 2005.

STANDARDS	PAGE REFERENCES
Organization of Living Things (LO) III.2	
All students will use classification systems to describe groups of living things:	
1. Compare and classify organisms into major groups on the basis of their structure. *Key concepts:* Characteristics used for classification—vertebrates/ invertebrates, coldblooded/warm-blooded, single-cell/multicellular, flowering/nonflowering; groups of vertebrates—mammals, birds, fish, reptiles, amphibians. *Observation tools:* Hand lens, microscope. *Real-world contexts:* Representative organisms, such as dog, worm, snake, Amoeba, geranium, bacterium, insect, mold.	See Glencoe's *Life Science* © 2005.
All students will compare and contrast differences in the life cycles of living things:	
2. Describe the life cycle of a flowering plant. *Key concepts:* Flowering plant parts and processes—roots, stems, leaves, flowers, fruits, seeds, embryo, pollen, ovary, egg cell, germination, fertilization. *Tools:* Microscope, hand lens. *Real-world contexts:* Common flowering plants, such as bean, tulip.	See Glencoe's *Life Science* © 2005.
All students will investigate and explain how living things obtain and use energy:	
3. Describe evidence that plants make and store food. Key concepts: Process and products of food production and transport—photosynthesis, starch, sugar, oxygen, carbon dioxide, water. See LO m.4 (use of food for energy.) Real-world contexts: Plant food storage organs, such as potato, onion; starch storage in plants grown under different conditions.	See Glencoe's *Life Science* © 2005.

STANDARDS	PAGE REFERENCES
All students will analyze how parts of living things are adapted to carry out specific functions:	
4. Explain how selected systems and processes work together in animals. *Key concepts:* Systems/Processes—digestion, circulation, respiration, endocrine, reproduction, skeletal, muscular, nervous, excretion, transport, growth, repair. *Real-world contexts:* Interrelations of body systems during selected activities, such as among skeletal, muscular, circulatory, and respiratory systems during physical exercise.	See Glencoe's *Life Science* © 2005.
Heredity (LH) III.3	
All students will investigate and explain how characteristics of living things are passed on through generations:	
1. Describe how the characteristics of living things are passed on through generations. *Key concepts:* Reproductive cells—egg, sperm. Chromosome, gene, hereditary information. *Real-world contexts:* Common traits controlled by a single gene pair, such as wrinkled or smooth seeds in a pea plant, color of horse hair; human traits such as tongue rolling.	See Glencoe's *Life Science* © 2005.
All students will explain why organisms within a species are different from one another:	
2. Describe how heredity and environment may influence/determine characteristics of an organism. *Key concepts:* Traits—inherited, acquired. *Real-world contexts:* Data on heredity, such as identical twin studies, effects of introduced toxins, effects of natural selection, effects of controlled selection and breeding.	See Glencoe's *Life Science* © 2005.

STANDARDS	PAGE REFERENCES
Evolution (LE) III.4	
All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species:	
1. Describe how scientific theory traces possible evolutionary relationships among present and past life forms. *Key concepts:* Selected evidence of common ancestry—geologic time, fossil, bone, embryo, limb. *Real-world contexts:* Fossils that show evidence of common ancestry, such as similarity of vertebrate limb bones, similarity of early vertebrate embryos, similarity of fossil bones to those of contemporary animals i.e., horse legs.	See Glencoe's *Life Science* © 2005.
All students will compare ways that living organisms are adapted (suited) to survive and reproduce in their environments and explain how species change through time:	
2. Explain how new traits might become established in a population and how species become extinct. *Key concepts:* Environmental change, variation in populations, reproductive success. *Real-world contexts:* Examples of inheritable and non-inheritable variations, such as white-eyed fruit fly or scars; examples of variations due to new gene combinations, such as hybrid organisms.	See Glencoe's *Life Science* © 2005.
Ecosystems (LEC) III.5	
All students will explain how parts of an ecosystem are related and how they interact:	
1. Describe common patterns of relationships among populations. *Key concepts:* Participants and relationships—predator, prey, parasite, competition, mutually beneficial. *Real-world contexts:* Relationships among plants and animals in an ecosystem—mutually helpful relationships, such as insects and flowering plants, birds eating fruit and spreading seeds; parasitic (harmful) relationships, such as humans and mosquitoes, trees and mistletoe; competitive relationships, including squirrels and seed-eating birds, weeds and garden plants.	See Glencoe's *Life Science* © 2005.

STANDARDS	PAGE REFERENCES
All students will explain how energy is distributed to living things in an ecosystem:	
2. Describe how organisms acquire energy directly or indirectly from sunlight. *Key concepts:* Sunlight, plants, food, photosynthesis, producers, consumers, food webs. See LO-III.2 m.3 (photosynthesis and food use). *Real-world contexts:* Selected food webs, including humans.	See Glencoe's *Life Science* © 2005.
All students will investigate and explain how communities of living things change over a period of time:	
3. Predict the effects of changes in one population in a food web on other populations. *Key concepts:* Natural balance, population, dependence, survival, community, biodiversity, introduction of non-native species. *Real-world contexts:* Plants and animals in an ecosystem dependent upon each other for survival in selected ecosystems—see LEC-III.5 e.2; comparison of animals and plants found in polluted vs. nonpolluted water, urban vs. rural settings, rural vs. forest settings; zebra mussels introduced into the Great Lakes, gypsy moths defoliating trees.	See Glencoe's *Life Science* © 2005.
4. Describe the likely succession of a given ecosystem over time. *Key concepts:* Succession, stages, climax community, pioneer. *Real-world contexts:* Process of gradual change in ecological systems, such as in ponds or abandoned farm fields.	See Glencoe's *Life Science* © 2005.
All students will analyze how humans and the environment interact:	
5. Explain how humans use and benefit from plant and animal materials. *Key concepts:* Materials from plants, including—wood, paper, cotton, linen, starch, rubber, wax, and oils. Materials from animals, including leather, wool, fur, oils, wax. *Real-world contexts:* Human-made objects that incorporate plant and animal materials, including clothing, building materials, machines, and medicines.	**Student Edition:** 257, 259-260 *National Geographic* 258 Also see Glencoe's *Life Science* © 2005.

STANDARDS	PAGE REFERENCES
6. Describe ways in which humans alter the environment. *Key concepts:* Agriculture, land use, renewable and non-renewable resource development, resource use, solid waste, toxic waste. Biodiversity. See EG-V.1 m.5, EH-V.2 m.3, EAW-V.3 m.4. *Real-world contexts:* Human activities, such as farming, pollution from manufacturing and other sources, hunting, habitat destruction, land development, reforestation, species reintroduction.	**Student Edition:** 259-263, 267-269, 648 *Applying Science* 269 *Design Your Own LAB* 344-345 *Science and Society* 718 *Science Online* 396 *Use the Internet LAB* 652-653 **Teacher Wraparound Edition:** A 262, 268; CC 167; D 257; DI 260, 268; II 718
IV. Using Physical Science Knowledge	
Matter and Energy (PME) IV.1	
All students will measure and describe the things around us:	
1. Describe and compare objects in terms of mass, volume, and density. *Key concepts:* Units of density—grams per cubic centimeter or grams per milliliter. *Measurement tools:* Balance, measuring cup or graduated cylinder, metric ruler. See C-I.1 m.4 (making measurements). *Real-world contexts:* Common objects and substances.	**Student Edition:** 18-19, 486 *MiniLAB* 19, 486 *Science Skill Handbook* 794 **Teacher Wraparound Edition:** A 18, 20; CC 18; R 21 **Teacher Resources:** *Chapter Resources* Solids, Liquids, and Gases 9-11 *Chapter Resources* The Nature of Science 13-15
2. Explain when length, mass, weight, density, area, volume or temperature are appropriate to describe the properties of an object or substance. *Key concepts:* Appropriate metric (s.i.) units. See C-I.1 m.4 (use measuring devices). *Measurement tools:* Balances, spring scales, measuring cups or graduated cylinders, thermometers, metric ruler. *Real-world contexts:* Common substances such as those listed in PME-IV.1 e.1; hot and cold substances, such as ice, snow, cold water, hot water, steam, cold air, hot air.	**Student Edition:** 14-19, 21, 486 *Applying Math* 16 *Design Your Own LAB* 28-29 *LAB* 27 *MiniLAB* 19, 486 *National Geographic* 20 **Teacher Wraparound Edition:** A 17, 20; CC 18, 19; DI 20; IM 15; QD 17; SJ 15 **Teacher Resources:** *Chapter Resources* Solids, Liquids, and Gases 9-11 *Chapter Resources* The Nature of Science 28, 31

STANDARDS	PAGE REFERENCES
All students will explain what the world around us is made of:	
3. Classify substances as elements, compounds, or mixtures and justify classifications in terms of atoms and molecules. *Key concepts:* Element, compound, mixture, molecule, atom. See PME-IV.1 m.4 (molecular structure of solids, liquids and gases). *Real-world contexts:* Common substances such as those listed above, including—elements, such as copper, aluminum, sulfur, helium, iron; compounds, such as water, salt, sugar, carbon dioxide; mixtures, such as soil, salt and pepper, salt water, air.	**Student Edition:** 450, 452-456 *LAB* 457 *MiniLAB* 453 *National Geographic* 451 *Science Stats* 468 **Teacher Wraparound Edition:** A 454, 468; D 452, 454; DI 455; IM 452; R 456; SJ 452; TFYI 453; TPK 450; USW 455; VL 454 **Teacher Resources:** *Chapter Resources* Classification of Matter 9-11, 27, 29, 42, 45-46
4. Describe the arrangement and motion of molecules in solids, liquids, and gases. *Key concepts:* Arrangement—regular pattern, random. Distance between molecules—closely packed, separated. Molecular motion—vibrating, bumping together, moving freely. (PCM-IV.2 m.4 addresses the molecular explanations of changes of state.) *Real-world contexts:* Common solids, liquids, and gases, such as those listed above.	**Student Edition:** 476-483 *LAB* 484 *Launch LAB* 475 *Science Online* 478 **Teacher Wraparound Edition:** DI (Challenge) 477; IM 474F, 480; LD 478; QD 477; R 483; SJ 482; UA 477 **Teacher Resources:** *Chapter Resources* Solids, Liquids, and Gases 35-36, 49-50
All students will explain how electricity (and magnetism; see PMO) interact with matter:	
5. Construct simple circuits and explain how they work in terms of the flow of current. *Key concepts and tools:* Complete circuit, incomplete circuit, short circuit, current, conductors, nonconductors, batteries, household current, bulbs, bells, motors, electrical switches. *Real-world contexts:* Household wiring, electrical conductivity testing, electric appliances.	**Student Edition:** 200-205, 207-210 *Design Your Own LAB* 214-215 *LAB* 206 *Launch LAB* 191 *MiniLAB* 202 **Teacher Wraparound Edition:** A 209; CA 213; IM 190F, 201; LD 208; QD 209; UA 203 **Teacher Resources:** *Chapter Resources* Electricity 9-10, 11-14, 17, 29, 30, 45-46

STANDARDS	PAGE REFERENCES
6. Investigate electrical devices and explain how they work, using instructions and appropriate safety precautions. *Key concepts:* Flow of electricity for energy or information transfer. Safety precautions for using electrical appliances; grounding. Documentation for toys and appliances—wiring diagrams, written instructions. (See PCM-IV.2 m.3, transformations of energy.) *Real-world contexts:* Situations requiring assembly, use, or repair of electrical toys, radios, or simple appliances, such as replacing batteries and bulbs; connecting electrical appliances, such as stereo systems, TV's and videocassette recorders, computers and computer components.	**Student Edition:** 198, 209-210, 235-237 *Design Your Own LAB* 246-247 *Integrate Career* 208 *Integrate Health* 205 *LAB* 245 **Teacher Wraparound Edition:** A 208; IL 234; IM 204; MM 210; VL 209 **Teacher Resources:** *Chapter Resources* Electricity 9-10, 29, 30 *Chapter Resources* Magnetism and Its Uses 29, 31, 32, 45, 47-48
Changes in Matter (PCM) IV.2	
All students will investigate, describe and analyze ways in which matter changes:	
1. Describe common physical changes in matter: evaporation, condensation, sublimation, thermal expansion and contraction. *Key concepts:* States of matter—solid, liquid, gas. Processes that cause changes of state or thermal effects: heating, cooling. Boiling. Mass/weight remains constant during physical changes in closed systems. *Real-world contexts:* States of matter—solid, liquid, gas. Changes in state, such as water evaporating as clothes dry, condensation on cold window panes, disappearance of snow or dry ice without melting; expansion of bridges in hot weather, expansion and contraction of balloons with heating and cooling; solid air fresheners.	**Student Edition:** 476-482 *LAB* 484 *Launch LAB* 475 **Teacher Wraparound Edition:** CU 465; IL 479; QD 481; SJ 481, 482 **Teacher Resources:** *Chapter Resources* Solids, Liquids, and Gases 13-18, 29, 32, 46, 48
2. Describe common chemical changes in terms of properties of reactants and products. *Key concepts:* Common chemical changes—burning, rusting iron, formation of sugars during photosynthesis, acid reacting with metal and other substances. Mass/weight remains constant in closed systems. *Real-world contexts:* Chemical changes—burning, photosynthesis, digestion, corrosion, acid reactions, common household chemical reactions such as with alkaline drain cleaners.	**Student Edition:** 461-465, 632-633, 637 *LAB* 466-467 *Launch LAB* 631 *MiniLAB* 460, 648 **Teacher Wraparound Edition:** IL 462; QD 464, 633; SJ 462 **Teacher Resources:** *Chapter Resources* Chemical Reactions 9-11, 13-16, 27 *Chapter Resources* Classification of Matter 13-16

STANDARDS	PAGE REFERENCES
All students will explain how visible changes in matter are related to atoms and molecules:	
3. Explain physical changes in terms of the arrangement and motion of atoms and molecules. *Key concepts:* Molecular descriptions of states of matter—see PME-IV.1 m.4. Changes in state of matter—melting, freezing, evaporation, condensation; thermal expansion and contraction see PCM-IV.2 m.1). Speed of molecular motion—moving faster, slower, vibrate, rotate, unrestricted motion; change in speed of molecular motion with change in temperature. *Real-world contexts:* See examples of physical changes of matter, PCM-IV.2 e.1 and m.1.	**Student Edition:** 476-482, 492-495, 677 **Teacher Wraparound Edition:** CU 483; LD 478; SJ 482; UA 477 **Teacher Resources:** *Chapter Resources* Solids, Liquids, and Gases 13-18, 49-50
All students will explain how changes in matter are related to changes in energy and how living things and human technology change matter and transform energy.	
4. Describe common energy transformations in everyday situations. *Key concepts:* Forms of energy, including mechanical, heat, sound, light, electrical, magnetic, chemical, food energy. See PME-IV.1 m.5 (electricity in circuits), PCM-IV.2 m.1 (energy in changes of state). Total amount of energy remains constant in all transformations. *Real-world contexts:* Motors, generators, power plants, light bulbs, appliances, cars, radios, TV's, walking, playing a musical instrument, cooking food, batteries, body heat, photosynthesis (see LO-III.2 m.3, LEC-III.5 m.2).	**Student Edition:** 107-115, 172-179, 207-213, 367-371, 646-649 *Design Your Own LAB* 116-117 **Teacher Wraparound Edition:** A 208, 649; CU 373; QD 173 **Teacher Resources:** *Chapter Resources* Electricity 9-10 *Chapter Resources* Electromagnetic Waves 13-15 *Chapter Resources* Energy 9-12 *Chapter Resources* Sound 11-14 *Chapter Resources* Thermal Energy 13-15
Motion of Objects (PMO) IV.3	
All students will describe how things around us move, explain why things move as they do, and demonstrate and explain how we control the motions of objects:	
1. Qualitatively describe and compare motion in two dimensions. *Key concepts:* Two-dimensional motion—up, down, curved path. Speed, direction, change in speed, change in direction. *Real-world contexts:* Objects in motion, such as thrown balls, roller coasters, cars on hills, airplanes.	**Student Edition:** 38-51 *Design Your Own LAB* 58-59 *MiniLAB* 42 **Teacher Wraparound Edition:** A 40, 46; IL 44; QD 41; SJ 44; VL 50 **Teacher Resources:** *Chapter Resources* Motion 13-15, 27, 30, 47-48

STANDARDS	PAGE REFERENCES
2. Relate motion of objects to unbalanced forces in two dimensions. *Key concepts:* Changes in motion and common forces—speeding up, slowing down, turning, push, pull, friction, gravity, magnets. Constant motion and balanced forces. Additional forces—attraction, repulsion, action/reaction pair (interaction force), buoyant force. Size of change is related to strength of unbalanced force and mass of object. *Real-world contexts:* Changing the direction—changing the direction of a billiard ball, bus turning a corner; changing the speed—car speeding up, a rolling ball slowing down, magnets changing the motion of objects, walking, swimming, jumping, rocket motion, objects resting on a table, tug-of-war.	**Student Edition:** 47-53, 68-72, 83-85, 485 *Design Your Own LAB* 58-59 *LAB* 57 *MiniLAB* 486 **Teacher Wraparound Edition:** CU 88; IM 53; LD 70; MM 54 **Teacher Resources:** *Chapter Resources* Motion 9-11, 29, 46, 49
3. Describe the non-contact forces exerted by magnets, electrically charged objects, and gravity. *Key concepts:* Electrical charges and magnetic poles—north pole, south pole, positive charge, negative charge; mass, weight, gravitational pull. Charging by rubbing or touching, electric attraction and repulsion. Force depends on size of charges or masses, and decreases quickly with distance. See PMO-IV.3 m.2 (forces and motion), PME-IV.1 m.2 (weight and mass). *Real-world contexts:* Electrically charged or polarized objects, such as balloons rubbed on clothing, bits of paper, salt grains, static cling, magnets, magnetic materials, earth's gravitational pull on objects near its surface, sun's gravitation pull on solar system objects (see ES-V.4 m.2).	**Student Edition:** 75-78, 193-194, 224-227 *Integrate Earth Science* 79 *MiniLAB* 198 **Teacher Wraparound Edition:** A 193; CU 199; QD 226; SJ 76, 193 **Teacher Resources:** *Chapter Resources* Electricity 25, 28 *Chapter Resources* Forces 20, 28 *Chapter Resources* Magnetism and Its Uses 9-12, 27
4. Use electric currents to create magnetic fields, and explain applications of this principle. *Key concepts:* Electric current, magnetic poles, magnetic fields. (See PME-IV.1 m.5, electric circuits.) *Tools:* Magnetic compass, battery, wire. *Real-world contexts:* Electromagnets, bells, speakers, motors, magnetic switches, Earth's magnetic field.	**Student Edition:** 224-237 *Design Your Own LAB* 246-247 *MiniLAB* 227, 229 **Teacher Wraparound Edition:** CU 230, 237; IL 234; QD 226, 233 **Teacher Resources:** *Chapter Resources* Magnetism and Its Uses 9-12, 13-16, 27, 28, 30, 31

STANDARDS	PAGE REFERENCES
5. Design strategies for moving objects by application of forces, including the use of simple machines. *Key concepts:* Types of simple machines—lever, pulley, screw, inclined plane, wedge, wheel and axle, gear; direction change, force advantage, speed and distance advantage. *Real-world contexts:* Objects being moved by using simple machines, such as wagons on inclined planes, heavy objects moved by levers, seesaw, cutting with knives or axes.	**Student Edition:** 132-146 *LAB* 147 *MiniLAB* 134 *Model and Invent LAB* 148-149 **Teacher Wraparound Edition:** A 133, 144; CU 137; DI 141; MM 141; QD 135 **Teacher Resources:** *Chapter Resources* Work and Machines 9-11, 13-18, 31, 34
Waves and Vibrations (PWV) IV.4	
All students will describe sounds and sound waves:	
1. Explain how sound travels through different media. *Key concepts:* Media—solids, liquids, gases. Vacuum. *Real-world contexts:* Sounds traveling through solids, such as glass windows, strings, the earth; sound traveling through liquids, such as dolphin and whale communication; sound traveling through gases, such as human hearing, sonic booms.	**Student Edition:** 320, 322-326, 331-332 *Design Your Own LAB* 344-345 *MiniLAB* 323 **Teacher Wraparound Edition:** CC 331; CU 326; D 323; R 326 **Teacher Resources:** *Chapter Resources* Sound 25, 30, 32, 44, 51
2. Explain how echoes occur and how they are used. *Key concepts:* Echo, sonar, reflection. *Real-world contexts:* Echoes in rooms—acoustics—and outdoors; practical uses of echoes, such as navigation by bats and dolphins, ultrasound imaging, sonar.	**Student Edition:** 339-343 *Chapter Review* 349 #22 *Science and History* 314 **Teacher Wraparound Edition:** A 340, 343; DI 340; R 343 **Teacher Resources:** *Chapter Resources* Sound 28, 47

STANDARDS	PAGE REFERENCES
All students will explain shadows, color, and other light phenomena:	
3. Explain how light is required to see objects. *Key concepts:* Light source, object, eye as a detector, illumination, path of light, reflection, absorption. See PWV-IV.4 m.2 (echo location). *Real-world contexts:* Seeing common objects in our environment; seeing "through" transparent media, such as windows, water; using flashlights to see in the dark.	**Student Edition:** 384-393, 416 *Design Your Own LAB* 406-407 *LAB* 405 *Launch LAB* 383 *MiniLAB* 387 **Teacher Wraparound Edition:** A 388, 392; R 388, 393; VL 386 **Teacher Resources:** *Chapter Resources* Light 13-16, 27, 46, 51-52
4. Describe ways in which light interacts with matter. *Key concepts:* Reflection, refraction, absorption, transmission, scattering, medium, lens. Transmission of light—transparent, translucent, opaque. *Real-world contexts:* Objects that reflect or absorb light, including mirrors; media that transmit light such as clear and frosted glass, clear and cloudy water, clear and smoky air; objects that refract light, including lenses, prisms, and fiber optics; uses of lenses, such as eye, cameras, telescope, microscope, magnifying lens, for magnification and lightgathering.	**Student Edition:** 384-393, 416-422, 424-426 *LAB* 423 *Launch LAB* 383 **Teacher Wraparound Edition:** A 388; IL 421; LD 426; QD 386; R 393 **Teacher Resources:** *Chapter Resources* Light 9-12 *Chapter Resources* Mirrors and Lenses 9-12, 13-16, 30, 31
All students will measure and describe vibrations and waves:	
5. Describe the motion of vibrating objects. *Key concepts:* Period, frequency, amplitude. *Real-world contexts:* Vibrating or oscillating objects, such as weights on springs, vocal cords, tuning forks, guitar strings.	**Student Edition:** 322-323, 333-336, 356-357 *LAB* 338 *Launch LAB* 321 **Teacher Wraparound Edition:** A 329, 335, 336; R 332; SJ 330; VL 356 **Teacher Resources:** *Chapter Resources* Sound 9-10, 11-14, 31

STANDARDS	PAGE REFERENCES
All students will explain how waves and vibrations transfer energy:	
6. Explain how mechanical waves transfer energy. *Key concepts:* Sound energy, absorption, transmission, reflection; media—air, solids, water. (See PME-IV.1 m.6, electrical circuits transfer electrical energy.) *Real-world contexts:* Waves in slinkies and long springs, sound waves, water waves, earthquakes.	**Student Edition:** 290-295, 303-311, 322-324 *LAB* 302 *Launch LAB* 289 **Teacher Wraparound Edition:** A 295; CU 295, 311, 326; LD 291 **Teacher Resources:** *Chapter Resources* Sound 9-10, 25 *Chapter Resources* Waves 13-15, 27
V. Using Earth Science Knowledge	
Geosphere (EG) V.1	
All students will describe the earth's surface:	
1. Describe and identify surface features using maps. *Key concepts:* Landforms—plains, deserts, plateaus, basin, Great Lakes, rivers, continental divide, mountains, mountain range, or mountain chain. *Tools:* Maps—relief, topographic, elevation. *Real-world contexts:* Maps showing continental and regional surface features, such as the Great Lakes or local topography.	**Student Edition:** *National Geographic* 166 **Teacher Wraparound Edition:** A 166 **Teacher Resources:** *Chapter Resources* Energy Sources 30
All students will describe and explain how the earth's features change over time:	
2. Explain how rocks are formed. *Key concepts:* Rock cycle processes—melting and cooling (igneous rocks); heat and pressure (metamorphic rocks); cementing and crystallization of sediments (sedimentary rocks). Minerals. Heat source is interior of earth. Materials—silt, clay, gravel, sand, rock, lava, magma, remains of living things (bones, shells, plants). *Real-world contexts:* Physical environments where rocks are being formed: volcanoes; depositional environments, such as ocean floor, deltas, beaches, swamps; metamorphic environments deep within the earth's crust.	See Glencoe's *Earth Science* © 2005.

STANDARDS	PAGE REFERENCES
3. Explain how rocks are broken down, how soil is formed and how surface features change. *Key concepts:* Chemical and mechanical weathering; erosion by glaciers, water, wind and downslope movement; decomposition, humus. *Real-world contexts:* Regions in Michigan where erosion by wind, water, or glaciers may have occurred, such as river valleys, gullies, shoreline of Great Lakes; chemical weathering from acid rain, formation of caves, caverns and sink holes; physical weathering, frost action such as potholes and cracks in sidewalks; plant roots by bacteria, fungi, worms, rodents, other animals.	**Student Edition:** 464 **Teacher Wraparound Edition:** QD 464; SJ 481
4. Explain how rocks and fossils are used to understand the age and geological history of the earth. *Key concepts:* Fossils, extinct plants and animals, ages of fossils, rock layers, timelines, relative dating. *Real-world contexts:* Fossils found in gravel, mines and quarries, museum displays; places where rock layers are visible, such as Pictured Rocks, quarries, Grand Canyon, road cuts; Michigan fossils, such as trilobites, brachiopods, Petosky stones; specific examples of extinct plants and animals, such as dinosaurs.	**Student Edition:** 544-545 *Integrate Earth Science* 267 *Science and History* 528 **Teacher Wraparound Edition:** DI 544
All students will analyze effects of technology on the earth's surface and resources:	
5. Explain how technology changes the surface of the earth. *Key concepts:* Types of human activities—surface mining, construction and urban development, farming, dams, landfills, restoring natural areas. *Real-world contexts:* Local example of surface changes due to human activities listed in the Key concepts above; local examples of negative consequences of these changes, such as groundwater pollution, destruction of habitat and scenic land, reduction of arable land; local examples of positive consequences, such as soil conservation, reforestation, restoring wetlands.	**Student Edition:** 273 *Integrate Career* 576 **Teacher Wraparound Edition:** DI 294

STANDARDS	PAGE REFERENCES
Hydrosphere (EH) V.2	
All students will describe the characteristics of water and demonstrate where water is found on earth:	
1. Use maps of the earth to locate water in its various forms and describe conditions under which they exist. *Key concepts:* Liquid water forms—lakes, rivers, oceans, springs. Frozen water forms—continental glacier, valley glacier, snow on mountains, polar cap. Gaseous water in atmosphere. *Tools:* Relief and elevation maps; satellite images *Real-world contexts:* Local lakes, rivers, streams, ponds, springs; examples of frozen water, including snow, glaciers, icebergs, polar regions, frozen Great Lakes shorelines.	**Student Edition:** 474 *National Geographic* 294 *Science and History* 528
All students will describe how water moves:	
2. Describe how surface water in Michigan reaches the ocean and returns. *Key concepts:* Water path—run-off, creeks, streams, wetlands, rivers, Great Lakes. Sources—snow melt, rain fall. Gravity. Water cycle—see EAW-V.3 m.3. (See EH-V.2 m.3 about groundwater.) *Real-world contexts:* Maps showing streams, lakes, rivers, oceans; examples of motions of rivers and lakes; investigations of rivers and lake temperatures; saltiness of ocean.	See Glencoe's *Earth Science* © 2005.
All students will analyze the interaction of human activities with the hydrosphere:	
3. Explain how water exists below the earth's surface and how it is replenished. *Key concepts:* Ground water—water table, spring, porous, saturate, filtration. Sources—snow melt, rain fall. *Real-world contexts:* Examples of groundwater, including springs, wells, water soaking into the ground.	See Glencoe's *Earth Science* © 2005.

STANDARDS	PAGE REFERENCES
4. Describe the origins of pollution in the hydrosphere. *Key concepts:* Sources of pollution—sewage, household dumping, industrial wastes, agricultural run-off. See EG-V.1 m.5, LEC-III.5 m.6. *Real-world contexts:* Examples of polluted water; examples of occasions when water supply is restricted, such as during droughts.	**Student Edition:** *Integrate History* 713
Atmosphere and Weather (EAW) V.3	
All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time:	
1. Explain patterns of changing weather and how they are measured. *Key concepts:* Weather patterns—cold front, warm front, stationary front, air mass, humidity. *Tools:* Thermometer, rain gauge, wind direction indicator, anemometer, weather maps, satellite weather images. *Real-world contexts:* Sudden temperature and cloud formation changes; records, charts, and graphs of weather changes over periods of days; lake effect snow.	**Student Edition:** *National Geographic* 197 **Teacher Wraparound Edition:** A 492; AIL 180
All students will explain what causes different kinds of weather:	
2. Describe the composition and characteristics of the atmosphere. *Key concepts:* Composition—air, molecules, gas, water vapor, dust particles, ozone. Characteristics—air pressure and temperature changes with altitude, humidity. *Real-world contexts:* Examples of characteristics of the atmosphere, including pressurized cabins in airplanes, demonstrations of air pressure; examples of air-borne particulates, such as smoke, dust, pollen, bacteria; effects of humidity, such as condensation, dew on surfaces, comfort level of humans.	**Student Edition:** 167, 222, 364 *Integrate Earth Science* 79 *National Geographic* 491 **Teacher Wraparound Edition:** A 491; D 468, 498; DI 491 **Teacher Resources:** *Chapter Resources* Chemical Reactions 48

STANDARDS	PAGE REFERENCES
3. Explain the behavior of water in the atmosphere. *Key concepts:* Water cycle—evaporation, water vapor, warm air rises, cooling, condensation, clouds. Precipitation—rain, snow, hail, sleet, freezing rain. Relative humidity, dew point, fog. See PCM-IV.2 m.1 (changes of state), EH-V.2 m.2 (water on the earth's surface). *Real-world contexts:* Aspects of the water cycle in weather, including clouds, fog, precipitation, evaporating puddles, flooding, droughts.	**Student Edition:** *Integrate Social Studies* 549 *National Geographic* 166
All students will analyze the relationships between human activities and the atmosphere:	
4. Describe health effects of polluted air. *Key concepts:* Effects—breathing difficulties, irritated eyes. Sources—car exhaust, industrial emissions. Acid rain. *Real-world contexts:* Locations and times where air quality is poor; local sources of potential air pollution; ozone warnings.	The effects of air pollution are discussed on: **Student Edition:** 262, 364 *Launch LAB* 695 *Science and Society* 718 *Use the Internet LAB* 652-653 **Teacher Wraparound Edition:** A 262; CC 364; II 718 **Teacher Resources:** *Chapter Resources* Acids, Bases, and Salts 13-16, 45
Solar System, Galaxy and Universe (ES) V.4	
All students will compare and contrast our planet and sun to other planets and star systems.	
1. Compare the earth to other planets and moons in terms of supporting life. *Key concepts:* Surface conditions—gravity, atmospheres, temperature. Relative distances, relative sizes. Sun produces the light and heat for each planet. Molecules necessary to support life—water, oxygen, nitrogen, carbon; see LC-III.1 m.2 (cell processes), LO-III.2 m.3 (photosynthesis), LEC-III.5 m.2 (light needed for energy). *Real-world contexts:* Examples of local and extreme conditions on earth vs. conditions on other planets; exploration of planets and their satellites.	See Glencoe's *Earth Science* © 2005.

STANDARDS	PAGE REFERENCES
All students will describe and explain how objects in the solar system move.	
2. Describe, compare, and explain the motions of solar system objects. *Key concepts:* Orbit, rotation (spin), axis, gravity, planets, moons, comets, asteroids, seasons. Tilt of the earth on its axis, direct/indirect rays. See PMO-IV.3 m.2 (force and change in motion) and PMO-IV.3 m.3 (gravity). *Real-world contexts:* Observations of comet motion over days and weeks, length of day and year on planets, changes in length of daylight and height of sun in sky; changes in daily temperature patterns; summer and winter solstices, spring and fall equinoxes.	**Student Edition:** 76, 82 *Science and History* 92
3. Describe and explain common observations of the night skies. *Key concepts:* Perceived and actual movement of the moon and planets across the sky, moon phases, eclipses, stars and constellations, planets, Milky Way, comets, comet tails, meteors. Sun is light source for all solar system objects (except meteors; friction with atmosphere), emitted light, reflected light (see PWVIV. 4 m.3 and m.4.) *Real-world contexts:* Outdoor observing of the skies, using telescopes and binoculars when available, as well as "naked-eye" viewing; viewing with robotic telescopes via the World Wide Web; telescopic and spacecraft-based photos of planets, moons, and comets; news reports of planetary and lunar exploration.	**Student Edition:** 434 *LAB* 438-439 **Teacher Wraparound Edition:** D 434 **Teacher Resources:** *Chapter Resources* Mirrors and Lenses 32