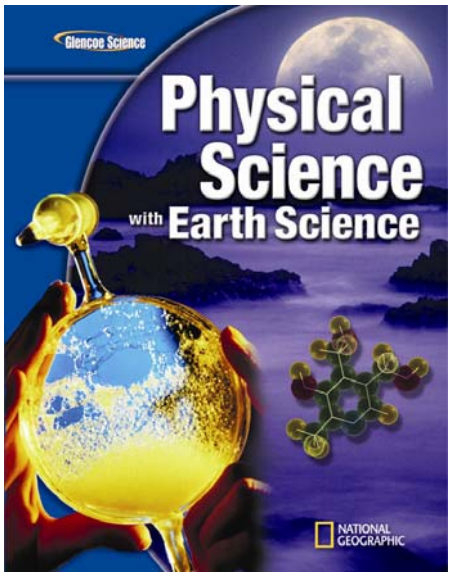
Academic Standards in Science
Grades 9-12

Minnesota



Physical Science with Earth Science

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STANDARDS	PAGE REFERENCES
1. The Nature of Science and Engineering	
1. The Practice of Science	
1. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	
9.1.1.1.1 Explain the implications of the assumption that the rules of the universe are the same everywhere and these rules can be discovered by careful and systematic investigation.	**Student Edition:** 12, 98-103, 104-111, 113-117, 132-133, 139-141, 149 #19, 833-835, 836-839 *Science Online* 105 *Integrate Earth Science* 108 *Science and History* 120, 146 **Teacher Wraparound Edition:** CB 120; FF 140; IA 105; SCB 96E-F; SJ 114; WQ 68

Codes used for Teacher Wraparound Edition pages are found on the last page of the correlation.

STANDARDS	PAGE REFERENCES
9.1.1.1.2 Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	**Student Edition:** 6-13, 35 #9, 38-45, 52, 218-219, 238-241 *Integrate History* 9, 273, 600 *Accidents in Science* 60, 744 *Science Online* 101 *National Geographic* 233 *Science and History* 810 **Teacher Wraparound Edition:** CB 178; DI 7; SCB 4E, 36E; V 233
9.1.1.1.3 Explain how the traditions and norms of science define the bounds of professional scientific practice and reveal instances of scientific error or misconduct. *For example:* The use of peer review, publications and presentations.	**Student Edition:** 10, 33 #22 *Science Skill Handbook* 858 **Teacher Wraparound Edition:** AIL 28; DI 23; PR 12
9.1.1.1.4 Explain how societal and scientific ethics impact research practices. *For example:* Research involving human subjects may be conducted only with the informed consent of the subjects.	**Student Edition:** 10, 46-50, 55, 63 #26; 65 #11 *MiniLAB* 47 *Applying Science* 49 *Science Online* 50 **Teacher Wraparound Edition:** ACT 50; CFU 50; DIS 49, 210; PR 12; R 50; RS 49
9.1.1.1.5 Identify sources of bias and explain how bias might influence the direction of research and the interpretation of data. *For example:* How funding of research can influence questions studied, procedures used, analysis of data, and communication of results.	**Student Edition:** 10, 33 #22 *Science Skill Handbook* 858 **Teacher Wraparound Edition:** DI 23; PR 12
9.1.1.1.6 Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge.	**Student Edition:** 6-13, 38-39, 218-219, 354-361, 581-583, 836-839 *Science and History* 120 *National Geographic* 233, 582 **Teacher Wraparound Edition:** ACT 233; BI 4; CFU 583; HS 120, 273; IL 12; SCB 36E, 216E; TFYI 99
9.1.1.1.7 Explain how scientific and technological innovations—as well as new evidence— can challenge portions of, or entire accepted theories and models including, but not limited to: cell theory, atomic theory, theory of evolution, plate tectonic theory, germ theory of disease, and the big bang theory.	**Student Edition:** 12, 38-39, 218-219, 238-241, 354-361, 836-839 *Science and History* 120 *National Geographic* 582 **Teacher Wraparound Edition:** CFU 583; DIS 239; HS 120; SCB 36E, 216E, 352E

STANDARDS	PAGE REFERENCES
2. Scientific inquiry uses multiple interrelated processes to investigate and explain the natural world.	
9.1.1.2.1 Formulate a testable hypothesis, design and conduct an experiment to test the hypothesis, analyze the data, consider alternative explanations and draw conclusions supported by evidence from the investigation.	**Student Edition:** *Design Your Own Lab* 28-29, 88-89, 144-145, 242-243, 344-345, 414-415, 446-447, 540-541, 568-569 *Lab* 196, 278-279, 742-743, 776-777 *Launch Lab* 577 *Model and Invent Lab* 808-809 **Teacher Wraparound Edition:** A 13, 134; IL 12; R 13
9.1.1.2.2 Evaluate the explanations proposed by others by examining and comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the scientifically acceptable evidence, and suggesting alternative scientific explanations.	**Student Edition:** *Communicating Your Data* 29, 89, 119, 209, 243, 279, 447, 569, 677, 775 *Accidents in Science* 60 **Teacher Wraparound Edition:** CC 10; EA 311
9.1.1.2.3 Identify the critical assumptions and logic used in a line of reasoning to judge the validity of a claim.	**Student Edition:** 10 *Communicating Your Data* 29, 209, 243, 447, 569, 637, 677, 775 **Teacher Wraparound Edition:** CC 10; CYD 279
9.1.1.2.4 Use primary sources or scientific writings to identify and explain how different types of questions and their associated methodologies are used by scientists for investigations in different disciplines.	**Student Edition:** 6-13 *Science Journal* 4 *Integrate History* 9 *Science and Language Arts* 30 *Integrate Life Science* 54 *Accidents in Science* 60, 210 *Science and History* 120, 478, 810 *Science Online* 579 *National Geographic* 744 *Integrate Social Studies* 799 **Teacher Wraparound Edition:** ACT 41; CC 162; CD 8; DI 10; RS 8; VL 7

STANDARDS	PAGE REFERENCES
2. The Practice of Engineering	
1. Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems.	
9.1.2.1.1 Understand that engineering designs and products are often continually checked and critiqued for alternatives, risks, costs and benefits, so that subsequent designs are refined and improved. *For example:* If the price of an essential raw material changes, the product design may need to be changed.	**Student Edition:** 52-57 *Section Review* 57 **Teacher Wraparound Edition:** TFYI 53
9.1.2.1.2 Recognize that risk analysis is used to determine the potential positive and negative consequences of using a new technology or design, including the evaluation of causes and effects of failures. *For example:* Risks and benefits associated with using lithium batteries.	**Student Edition:** 40-45, 46-50, 52-57 *Science Online* 45 *MiniLAB* 47 *Applying Science* 49 **Teacher Wraparound Edition:** A 45, 57; ACT 48; DI 44; PR 50; RS 49; TFYI 48
9.1.2.1.3 Explain and give examples of how, in the design of a device, engineers consider how it is to be manufactured, operated, maintained, replaced and disposed of.	**Student Edition:** 52-57, 494-499 *Section Review* 57 **Teacher Wraparound Edition:** ACT 55; DI 56; DIS 499
2. Engineering design is an analytical and creative process of devising a solution to meet a need or solve a specific problem.	
9.1.2.2.1 Identify a problem and the associated constraints on possible design solutions. *For example:* Constraints can include time, money, scientific knowledge and available technology.	**Student Edition:** *Unit Project* 3, 67, 85, 251, 389, 685 *Model and Invent Lab* 58-59 *Design Your Own Lab* 344-345 **Teacher Wraparound Edition:** A 444; AIL 88; DI 169; IL 54, 274, 434; MM 56
9.1.2.2.2 Develop possible solutions to an engineering problem and evaluate them using conceptual, physical and mathematical models to determine the extent to which the solutions meet the design specifications. *For example:* Develop a prototype to test the quality, efficiency and productivity of a product.	**Student Edition:** *Unit Project* 3, 67, 85, 251, 389, 685 *Model and Invent Lab* 58-59 *Design Your Own Lab* 344-345 **Teacher Wraparound Edition:** AIL 88; DI 169; IL 54, 274, 434; MM 56

STANDARDS	PAGE REFERENCES
3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	
1. Natural and designed systems are made up of components that act within a system and interact with other systems.	
9.1.3.1.1 Describe a system, including specifications of boundaries and subsystems, relationships to other systems, and identification of inputs and expected outputs. *For example:* A power plant or ecosystem.	**Student Edition:** 56, 218-222, 223-229, 231-237, 272-277, 435-437, 438-444, 831-835 *Integrate Environment* 139 *Science Online* 274 *National Geographic* 441 **Teacher Wraparound Edition:** A 277; BI 184; SCB 216E-F; SJ 273; TPK 46
9.1.3.1.2 Identify properties of a system that are different from those of its parts but appear because of the interaction of those parts.	**Student Edition:** 56, 218-222, 223-229, 231-237, 272-277, 438-444, 831-835 *Integrate Environment* 139 *Science Online* 274 *National Geographic* 441 **Teacher Wraparound Edition:** A 277; BI 184; SCB 216E-F
9.1.3.1.3 Describe how positive and/or negative feedback occur in systems. *For example:* The greenhouse effect.	**Student Edition:** 56, 142, 162-165, 272-274, 407-413, 494-496, 536-539, 801-803 *Science and History* 146 *Lab* 807 **Teacher Wraparound Edition:** BI 152, 390; CD 273; IH 273; SCB 215E, 516F; TFYI 276; UAA 496
2. Men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in scientific inquiry and engineering design.	
9.1.3.2.1 Provide examples of how diverse cultures, including natives from all of the Americas, have contributed scientific and mathematical ideas and technological inventions. *For example:* Native American understanding of ecology; Lisa Meitner's contribution to understanding radioactivity; Tesla's ideas and inventions relating to electricity; Watson, Crick and Franklin's discovery of the structure of DNA; or how George Washington Carver's ideas changed land use.	**Student Edition:** 98-103, 218-219 *Integrate History* 9, 273 *Accidents in Science* 28, 61, 210 *Science and History* 120, 478, 810 **Teacher Wraparound Edition:** CC 156; CD 17, 43, 115, 132, 187, 336, 410; VL 41

STANDARDS	PAGE REFERENCES
9.1.3.2.2 Analyze possible careers in science and engineering in terms of education requirements, working practices and rewards.	**Student Edition:** 6-13, 35 #14 *Unit Project* 3, 67, 685 *Science and Language Arts* 30 *Integrate Career* 56, 114, 335, 408, 410, 472, 592, 753 *Science Online* 101 **Teacher Wraparound Edition:** PR 56; TPK 6; VL 7
3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	
3. Science and engineering operate in the context of society and both influence and are influenced by this context.	
9.1.3.3.1 Describe how values and constraints affect science and engineering. *For example*: Economic, environmental, social, political, ethical, health, safety and sustainability issues.	**Student Edition:** 10, 42-45, 46-50, 52-57 *National Geographic* 44 *Science Online* 45, 50 *MiniLAB* 47 *Applying Science* 49 **Teacher Wraparound Edition:** A 45; ACT 44, 48; AIL 344; CFU 50; DI 23, 44; PR 12; RS 49; SCB 36E
9.1.3.3.2 Communicate, justify and defend the procedures and results of a scientific inquiry or engineering design project using verbal, graphic, quantitative, virtual or written means.	**Student Edition:** 22-26 *Lab* 27, 87, 118-119, 278-279, 636-637, 776-777 *Design Your Own Lab* 28-29, 88-89, 134, 144-145, 242-243, 414-415, 446-447, 540-541 **Teacher Wraparound Edition:** A 27, 177; DI 24
9.1.3.3.3 Describe how scientific investigations and engineering processes require multi-disciplinary contributions and efforts. *For example:* Nanotechnology, climate change, agriculture or biotechnology.	**Student Edition:** 6, 42-45, 52, 227-229, 462-467 *Science Online* 101, 172, 227, 256 *Science and History* 312, 448, 810 *Science and Society* 178 **Teacher Wraparound Edition:** A 324; AIL 88; IL 464; V 44

STANDARDS	PAGE REFERENCES
4. Science, technology, engineering and mathematics rely on each other to enhance knowledge and understanding.	
9.1.3.4.1 Describe how technological problems and advances often create a demand for new scientific knowledge, improved mathematics and new technologies.	**Student Edition:** 13, 38-45, 52-53, 326, 431-437, 804-806 *Science Online* 172, 234, 325 *Science and Society* 178 *Accidents in Science* 210 *Integrate Physics* 358 **Teacher Wraparound Edition:** ACT 275; CB 178; BI 36; DIS 53; HS 312, 810; SCB 4E
9.1.3.4.2 Determine and use appropriate safety procedures, tools, computers and measurement instruments in science and engineering contexts. *For example:* Consideration of chemical and biological hazards in the lab.	**Student Edition:** 17-21 *MiniLAB* 19, 25 *Lab* 87, 118-119, 196, 278-279, 636-637, 776-777 *Design Your Own Lab* 88-89, 144-145, 242-243, 414-415, 446-447, 540-541 *Launch Lab* 127 *Model and Invent Lab* 176-177
9.1.3.4.3 Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.	**Student Edition:** 22-26, 74-75 *Lab* 27, 118-119, 278-279, 776-777 *Applying Math* 72 *Design Your Own Lab* 88-89, 144-145, 242-243, 540-541 *Model and Invent Lab* 176-177 **Teacher Wraparound Edition:** AIL 742; DI 24; SCB 4F
9.1.3.4.4 Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve data collection and analysis. *For example*: Use statistical analysis or error analysis to make judgments about the validity of results.	**Student Edition:** *Design Your Own Lab* 28-29, 144-145 *Applying Math* 72, 220 **Teacher Wraparound Edition:** DI 23; DIS 23; EA 89, 119, 243, 279, 311, 381, 447, 637, 777

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9.1.3.4.5 Demonstrate how unit consistency and dimensional analysis can guide the calculation of quantitative solutions and verification of results.	**Student Edition:** 14-21 *Launch Lab* 4 *Section Review* 21 *Design Your Own Lab* 28-29 *Communicating Your Data* 279 *Lab* 379 *Applying Math* 621, 757 **Teacher Wraparound Edition:** AIL 28, 414; DI 15; QD 17; TFYI 116
9.1.3.4.6 Analyze the strengths and limitations of physical, conceptual, mathematical and computer models used by scientists and engineers.	**Student Edition:** 11, 55, 218-219, 354-355, 581-583, 607 #20 *Integrate Physics* 30 *Section Review* 222 *MiniLAB* 581 *National Geographic* 582 **Teacher Wraparound Edition:** ACT 11; DI 581; DIS 11; SCB 516F; VL 11, 55, 581
Science	
1. Matter	
1. The structure of the atom determines chemical properties of elements.	
9.2.1.1.1 Describe the relative charges, masses, and locations of the protons, neutrons, and electrons in an atom of an element.	**Student Edition:** 392-393, 578-583, 584-587 *MiniLAB* 581, 585 *National Geographic* 582 *Applying Math* 587 **Teacher Wraparound Edition:** A 581, 583; ACT 787; DI 579; DIS 585; IM 586; QD 585; R 583; UA 393; V 582
9.2.1.1.2 Describe how experimental evidence led Dalton, Rutherford, Thompson, Chadwick and Bohr to develop increasingly accurate models of the atom.	**Student Edition:** 581-583, 605#12, 605#14 *National Geographic* 582 *Section Review* 583 **Teacher Wraparound Edition:** ACT 582; CFU 583; SCB 576E; UAA 580; V 582; VL 581

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9.2.1.1.3 Explain the arrangement of the elements on the Periodic Table, including the relationships among elements in a given column or row.	**Student Edition:** 588-592 *MiniLAB* 581 *Lab* 597 **Teacher Wraparound Edition:** CC 593; DI 590, 592; IM 593; PR 595; QD 590; R 596; TFYI 589, 590; TPK 588; VL 590
9.2.1.1.4 Explain that isotopes of an element have different numbers of neutrons and that some are unstable and emit particles and/or radiation. *For example:* Some rock formations and building materials emit radioactive radon gas. *Another example:* The predictable rate of decay of radioactive isotopes makes it possible to estimate the age of some materials, and makes them useful in some medical procedures.	**Student Edition:** 586-587, 605 #7, 672-673, 788-790, 804 *Applying Science* 586 *Integrate Life Science* 586 *Applying Math* 603 *Integrate Chemistry* 804 **Teacher Wraparound Edition:** A 587, 790; DI 586; PR 587; R 790; VL 586
2. Chemical reactions involve the rearrangement of atoms as chemical bonds are broken and formed through transferring or sharing of electrons and the absorption or release of energy.	
9.2.1.2.1 Describe the role of valence electrons in the formation of chemical bonds.	**Student Edition:** 594, 694-702, 717 #12, 717 #15 *National Geographic* 699 *Section Review* 702 *Model and Invent Lab* 710-711 **Teacher Wraparound Edition:** A 702; ACT 697, 699; DI 697; DIS 696; IL 697; SCB 576F; SJ 697; V 699; VL 695
9.2.1.2.2 Explain how the rearrangement of atoms in a chemical reaction illustrates the law of conservation of mass.	**Student Edition:** 567, 720-725, 747#21 *Science Online* 722 *Applying Math* 725 *Section Review* 725 **Teacher Wraparound Edition:** A 569; AIL 568; DIS 723; IM 728; PR 724; QD 722; SCB 718E

STANDARDS	PAGE REFERENCES
9.2.1.2.3 Describe a chemical reaction using words and symbolic equations. *For example:* The reaction of hydrogen gas with oxygen gas can be written: $2H_2 + O_2 \rightarrow 2H_2O$.	**Student Edition:** 720-725, 726-729 *Launch Lab* 719 *MiniLAB* 724 *Science Online* 727 *Applying Math* 728 **Teacher Wraparound Edition:** A 719, 725; BI 718; CFU 729; DI 727; PR 724; R 725, 729; SCB 718E-F; VL 724
9.2.1.2.4 Relate exothermic and endothermic chemical reactions to temperature and energy changes.	**Student Edition:** 734-740, 749#12 *Integrate Life Science* 735 *Section Review* 740 *Lab* 741 **Teacher Wraparound Edition:** A 740; LD 736; R 740; USW 735
2. Motion	
2. An object's mass and the forces on it affect the motion of an object.	
9.2.2.2.1 Recognize that inertia is the property of an object that causes it to resist changes in motion.	**Student Edition:** 98-101 *MiniLAB* 99 *Section Review* 103 **Teacher Wraparound Edition:** BI 96; DI 100, 105; MM 100; RS 99; TFYI 99; V 115
9.2.2.2.2 Explain and calculate the acceleration of an object subjected to a set of forces in one dimension (F=ma).	**Student Edition:** 101-103, 125 #12 *Applying Math* 102, 103, 123 *National Geographic* 115 *Lab* 118-119 **Teacher Wraparound Edition:** ACT 115; BI 96; DI 105, 116; QD 102; SCB 96E; V 115
9.2.2.2.3 Demonstrate that whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted by the second object back on the first object.	**Student Edition:** 113-117 *National Geographic* 115 *Lab* 118-119 **Teacher Wraparound Edition:** ACT 115; CD 115; FF 115; PR 116; QD 115; SCB 96F; SJ 114; TPK 113; VL 114

STANDARDS	PAGE REFERENCES
2. Forces and object mass determine the motion of an object.	
9.2.2.2.4 Use Newton's universal law of gravitation to describe and calculate the attraction between massive objects based on the distance between them. *For example:* Calculate the weight of a person on different planets in the solar system.	**Student Edition:** 105-108 *Science Online* 105 *Section Review* 111 **Teacher Wraparound Edition:** FF 105; RS 105; SCB 96E; SJ 106
3. Energy	
2. Energy can be transformed within a system or transferred to other systems or the environment, but is always conserved.	
9.2.3.2.1 Identify the energy forms and explain the transfers of energy involved in the operation of common devices. *For example*: Light bulbs, electric motors, automobiles or bicycles.	**Student Edition:** 128-133; 135-143; 407-413, 431-437, 438-444, 486-493, 501-506 *Launch Lab* 127 *MiniLAB* 131 *National Geographic* 138 **Teacher Wraparound Edition:** A 127; R 133; SCB 390E; SJ 129, 139; VL 137, 433
9.2.3.2.2 Calculate and explain the energy, work and power involved in energy transfers in a mechanical system. *For example:* Compare walking and running up or down steps.	**Student Edition:** 154-159, 160-165 *MiniLAB* 140, 157 *Design Your Own Lab* 144-145 *Applying Math* 156, 158 **Teacher Wraparound Edition:** AIL 144; BI 152; CC 158; DI 136, 155; IM 152F; QD 156; SCB 152E; SJ 155
9.2.3.2.3 Describe how energy is transferred through sound waves and how pitch and loudness are related to wave properties of frequency and amplitude.	**Student Edition:** 320-326 *Launch Lab* 319 *MiniLAB* 323 **Teacher Wraparound Edition:** A 323, 326; ACT 321; DI 323; DIS 323; IM 321; R 326; RS 321; SCB 318E; TFYI 322; VL 324

STANDARDS	PAGE REFERENCES
9.2.3.2.4 Explain and calculate current, voltage and resistance, and describe energy transfers in simple electric circuits.	**Student Edition:** 400-405, 407-413 *Launch Lab* 391 *MiniLAB* 402 *Applying Math* 405, 411, 413 *Integrate Health* 405 *Design Your Own Lab* 414-415 **Teacher Wraparound Edition:** CFU 405; IM 390F, 401, 404; LD 408; QD 401; SCB 390E; TFYI 401; TPK 400
9.2.3.2.5 Describe how an electric current produces a magnetic force, and how this interaction is used in motors and electromagnets to produce mechanical energy.	**Student Edition:** 431-437, 438-444 *Science Online* 437 *National Geographic* 441 *Lab* 445 *Design Your Own Lab* 446-447 **Teacher Wraparound Edition:** BI 422; CC 433; CFU 437; DI 436; MM 436; QD 433; R 437; SCB 422E; TFYI 432; TPK 431; VL 433
9.2.3.2.6 Compare fission and fusion in terms of the reactants, the products and the conversion from matter into energy. *For example:* The fusion of hydrogen produces energy in the sun. *Another example:* The use of chain reactions in nuclear reactors.	**Student Edition:** 141, 494-500, 515#8-9, 720, 801-806 *Science Online* 141, 803 *MiniLAB* 802 *Lab* 807 **Teacher Wraparound Edition:** A 499; CFU 500, 806; MM 803; R 806; TFYI 141, 803; TPK 801; UAA 496; USW 141
9.2.3.2.7 Describe the properties and uses of forms of electromagnetic radiation from radio frequencies through gamma radiation. *For example:* Compare the energy of microwaves and X-rays.	**Student Edition:** 456-461, 462-467, 469-475 *Launch Lab* 455 *MiniLAB* 463 *Integrate Health* 465 *Use the Internet Lab* 476-477 **Teacher Wraparound Edition:** A 458, 461, 467; ACT 460; CFU 461, 467; DI 464; DIS 466; QD 465; R 467; SCB 454E-F; VL 458

STANDARDS	PAGE REFERENCES
4. Human Interaction with Physical Systems	
1. There are benefits, costs and risks to different means of generating and using energy.	
9.2.4.1.1 Compare local and global environmental and economic advantages and disadvantages of generating electricity using various sources or energy. *For example:* Fossil fuels, nuclear fission, wind, sun or tidal energy.	**Student Edition:** 486-493, 494-500, 501-506 *Launch Lab* 485 *Applying Science* 499 *Lab* 507 *Use the Internet Lab* 508-509 *Science and Society* 510 **Teacher Wraparound Edition:** ACT 492; CC 489, 495; CD 489; DI 487; DIS 492, 503, 506; IL 490; PR 493; R 493
9.2.4.1.2 Describe the trade-offs involved when technological developments impact the way we use energy, natural resources, or synthetic materials. *For example:* Fluorescent light bulbs use less energy than incandescent lights, but contain toxic mercury.	**Student Edition:** 466 *Use the Internet Lab* 508-509 *Science and Society* 510 *Science Online* 770 **Teacher Wraparound Edition:** A 806; CC 495; DI 804; DIS 499, 510; IE 466; PR 500, 806; RS 466; SCB 784E-F; SJ 465, 802
3. Earth and Space Science	
1. Earth Structure and Processes	
1. The relationships among earthquakes, mountains, volcanoes, fossil deposits, rock layers and ocean features provide evidence for the theory of plate tectonics.	
9.3.1.1.1 Compare and contrast the interaction of tectonic plates at convergent and divergent boundaries. *For example:* Compare the kinds of magma that emerge at plate boundaries.	**Student Edition:** 358-361, 385 #14, 387 #9-10 *Section Review* 361 **Teacher Wraparound Edition:** A 361; CFU 361; RS 360
9.3.1.1.2 Use modern earthquake data to explain how seismic activity is evidence for the process of subduction. *For example:* Correlate data on distribution, depth and magnitude of earthquakes with subduction zones.	**Student Edition:** 359, 362-369, 387#18 *Figure 12* 363
9.3.1.1.3 Describe how the pattern of magnetic reversals and rock ages on both sides of a mid-ocean ridge provides evidence of sea-floor spreading.	**Student Edition:** 356-358, 387 #8, 387 #13 *Applying Math* 357 **Teacher Wraparound Edition:** PR 360; SCB 352E

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9.3.1.1.4 Explain how the rock record provides evidence for plate movement. *For example:* Similarities found in fossils, certain types of rocks, or patterns of rock layers in various locations.	**Student Edition:** 353-361, 387 #13 *Launch Lab* 353 **Teacher Wraparound Edition:** ACT 355; MM 355; VL 356
9.3.1.1.5 Describe how experimental and observational evidence led to the theory of plate tectonics.	**Student Edition:** 353-361, 387 #8 *Science Online* 82 *Launch Lab* 353 *Applying Math* 357 **Teacher Wraparound Edition:** ACT 355; DIS 355; MM 355; PR 360; SCB 352E; UAA 357; VL 356
3. By observing rock sequences and using fossils to correlate the sequences at various locations, geologic events can be inferred and geologic time can be estimated.	
9.3.1.3.1 Use relative dating techniques to explain how the structures of the Earth and life on Earth have changed over short and long periods of time.	**Student Edition:** 669-675 *Section Review* 675 *Lab* 676-677 **Teacher Wraparound Edition:** AIL 677; RS 670; VL 671, 674
9.3.1.3.2 Cite evidence from the rock record for changes in the composition of the global atmosphere as life evolved on Earth. *For example*: Banded iron formations as found in Minnesota's Iron Range.	**Student Edition:** 518-519, 545 #25* **Teacher Wraparound Edition:** R 522 * These references discuss changes in Earth's atmosphere as life evolved on Earth; they do not refer to the rock record.
2. Interdependence Within the Earth System	
1. The Earth system has internal and external sources of energy, which produce heat and drive the motion of material in the oceans, atmosphere and solid earth.	
9.3.2.1.1 Compare and contrast the energy sources of the Earth, including the sun, the decay of radioactive isotopes and gravitational energy.	**Student Edition:** 193-195, 268, 501, 520, 536 *MiniLAB* 195 *Lab* 196 *National Geographic* 268 *Applying Math* 270 **Teacher Wraparound Edition:** A 270; ACT 193; LD 193; SCB 515E

STANDARDS	PAGE REFERENCES
9.3.2.1.2 Explain how the outward transfer of Earth's internal heat drives the convection circulation in the mantle to move tectonic plates.	**Student Edition:** 267, 360-361, 387#14 *Section Review* 361 **Teacher Wraparound Edition:** QD 268, 360; RS 532; SCB 184E, 252F; TFYI 361
2. Global climate is determined by distribution of energy from the sun at the Earth's surface.	
9.3.2.2.1 Explain how Earth's rotation, ocean currents, configuration of mountain ranges, and composition of the atmosphere influence the absorption and distribution of energy, which contributes to global climatic patterns.	**Student Edition:** 267-269, 524-525, 529-534 *Integrate Earth Science* 258 *National Geographic* 268 *MiniLAB* 525 *Section Review* 528 **Teacher Wraparound Edition:** ACT 268; AIL 278; QD 533; RS 268; SCB 516E; TFYI 532; VL 525
9.3.2.2.2. Explain how evidence from the geologic record, including ice core samples, indicates that climate changes have occurred at varying rates over geologic time and continue to occur today.	**Student Edition:** 535-539 *Integrate History* 536 *Science and History* 600 **Teacher Wraparound Edition:** CB 600; FF 538; HS 600; SCB 516F
3. The cycling of materials through different reservoirs of the Earth's system is powered by the Earth's sources of energy.	
9.3.2.3.1 Trace the cyclical movement of carbon, oxygen and nitrogen through the lithosphere, hydrosphere, atmosphere and biosphere. *For example:* The burning of fossil fuels contributes to the greenhouse effect.	**Student Edition:** 518-519, 536-539 *Applying Math* 537 **Teacher Wraparound Edition:** LD 537; RS 537; TFYI 537; VL 536
3. The Universe	
2. The solar system, sun, and Earth formed over billions of years.	
9.3.3.2.1 Describe how the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.	**Student Edition:** 220-222 **Teacher Wraparound Edition:** A 222; PR 222; R 222; SCB 216E; VL 221

STANDARDS	PAGE REFERENCES
9.3.3.2.2. Explain how the Earth evolved into its present habitable form through interactions among the solid earth, the oceans, the atmosphere and organisms.	**Student Edition:** 189, 225, 238-241, 247 #30, 518-519, 545 #25 *Integrate Earth Science* 108 *Section Review* 241 **Teacher Wraparound Edition:** DIS 239; R 241; SCB 216E; VL 239
9.3.3.2.3. Compare and contrast the environmental conditions that make life possible on Earth with conditions found on the other planets and moons of our solar system.	**Student Edition:** 189, 223-229, 231-237, 238-241, 249 #14-15 *Science Online* 187 *Section Review* 229 *Design Your Own Lab* 242-243 **Teacher Wraparound Edition:** A 241, 243; AIL 242; IM 226; QD 240; R 241; SCB 216E-F; SJ 224; TFYI 227, 228; TPK 238; VL 240
3. The big bang theory states that the universe expanded from a hot, dense chaotic mass, after which chemical elements formed and clumped together to eventually form stars and galaxies.	
9.3.3.3.1 Explain how evidence, including the Doppler shift of light from distant stars and cosmic background radiation, is used to understand the composition, early history and expansion of the universe.	**Student Edition:** 836-839 *Integrate Astronomy* 324 *Section Review* 839 *Model and Invent Lab* 840-841 **Teacher Wraparound Edition:** A 839, 841; FF 837, 840; QD 838; RS 837
9.3.3.3.2 Explain how gravitational clumping leads to nuclear fusion, producing energy and the chemical elements of a star.	**Student Edition:** 221, 596, 823-825, 833 *Section Review* 829 **Teacher Wraparound Edition:** VL 221

STANDARDS	PAGE REFERENCES
4. Human Interactions with the Earth System	
1. People consider potential benefits, costs and risks to make decisions on how they interact with natural systems.	
9.3.4.1.1 Analyze the benefits, costs, risks and tradeoffs associated with natural hazards, including the selection of land use and engineering mitigation. *For example:* Determining land use in floodplains and areas prone to landslides.	**Student Edition:** 39, 362-369, 527-528, 657 *Science Online* 359, 376 *National Geographic* 368 *Integrate History* 377 *Lab* 380-381 *Science and History* 382 **Teacher Wraparound Edition:** A 528; ACT 655; CB 382; CC 377; SJ 660; V 368
9.3.4.1.2 Explain how human activity and natural processes are altering the hydrosphere, biosphere, lithosphere and atmosphere, including pollution, topography and climate. *For example:* Active volcanoes and the burning of fossil fuels contribute to the greenhouse effect.	**Student Edition:** 536-539, 654-662, 668 *Science and History* 382 *Applying Math* 537 **Teacher Wraparound Edition:** A 539, 668; ACT 492, 538; CFU 539; DI 660; DIS 658; LD 537; PR 539; R 539; RS 537; SCB 516F; TFYI 519, 537

Codes Used for Teacher Edition pages

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A	Assessment
ACT	Activity
AIL	Alternative Inquiry Lab
BI	Big Idea
CB	Content Background
CC	Curriculum Connection
CD	Cultural Diversity
CFU	Check for Understanding
CYD	Communicating Your Data
DI	Differentiated Instruction
DIS	Discussion
EA	Error Analysis
FF	Fun Fact
HS	Historical Significance
IA	Integrate Astronomy
IE	Integrate Environment
IH	Integrate History
IL	Inquiry Lab
IM	Identify Misconceptions
LD	Lab Demonstration
MM	Make a Model
PR	Post Reading
R	Reteach
RS	Reading Strategy
SCB	Science Content Background
SJ	Science Journal
TFYI	Teacher FYI
TPK	Tie to Prior Knowledge
UAA	Use an Analogy
USW	Use Science Words
V	Visualizing
VL	Visual Learning
WQ	Web Quest