



COLORADO
Science Content Standards Grades 9-12
Physical Science © 2005

OBJECTIVES	PAGE REFERENCES
STANDARD 1: Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> asking questions and stating hypotheses, using prior scientific knowledge to help guide their development; 	SE: <i>Lab</i> 27, 90-91, 116-117, 277, 344-345, 366, 496-497, 651, 680, 778-779
<ul style="list-style-type: none"> creating and defending a written plan of action for a scientific investigation; 	SE: <i>Lab</i> 28-29, 58-59, 116-117, 214-215, 344-345, 406-407, 592-593, 716-717 <i>Science Skill Handbook</i> 791-792 <i>Technology Skill Handbook</i> 813-816
<ul style="list-style-type: none"> selecting and using appropriate technologies to gather, process, and analyze data and to report information related to an investigation; 	SE: 18-21, 24-26 <i>Lab</i> 28-29, 278-279, 366, 651, 706, 778-779 <i>Science Skill Handbook</i> 792-796 <i>Technology Skill Handbook</i> 813-816
<ul style="list-style-type: none"> identifying major sources of error or uncertainty within an investigation (<i>for example, particular measuring devices and experimental procedures</i>); 	SE: <i>Lab</i> 28-29, 58-59, 180-181, 246-247, 466-467, 496-497, 686-687, 716-717, 748-749, 778-779
<ul style="list-style-type: none"> constructing and revising scientific explanations and models, using evidence, logic, and experiments that include identifying and controlling variables; 	SE: 7-11 <i>Lab</i> 58-59, 214-215, 466-467, 778-779 <i>Science and History</i> 92, 560 <i>Science and Society</i> 280, 718 <i>Science Skill Handbook</i> 792-794
<ul style="list-style-type: none"> communicating and evaluating scientific thinking that leads to particular conclusions; 	SE: 7-12 <i>Accidents in Science</i> 654 <i>National Geographic</i> 2 <i>Science and Language Arts</i> 30 <i>Science and Society</i> 150, 718, 780 <i>Science Skill Handbook</i> 795-796
<ul style="list-style-type: none"> recognizing and analyzing alternative explanations and models; and 	SE: 12, 506-509, 516-517 <i>Integrate Astronomy</i> 76 <i>Integrate Earth Science</i> 45-46 <i>National Geographic</i> 510 <i>Science and History</i> 118, 560 <i>Science and Society</i> 718 TWE: SJ 11
<ul style="list-style-type: none"> explaining the difference between a scientific theory and a scientific hypothesis. 	SE: 8, 12, 476, 506-511, 551-552, 632-634 <i>Science and History</i> 376 <i>Science Skill Handbook</i> 791-792 TWE: A 45 SJ 11

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For students continuing their science education beyond the standards, what they know and are able to do may include	
<ul style="list-style-type: none"> designing and completing an advanced scientific investigation—either individually or as part of a student team—that extends over several days or weeks; and 	SE: Lab 278-279, 344-345, 525, 526-527, 652-653 TWE: DIN 15 IN 92 SJ 175
<ul style="list-style-type: none"> continuing to practice and apply inquiry skills as they extend their understanding of science content through further study. 	SE: 7-10 Lab 278-279, 652-653 <i>National Geographic</i> 188, 566 <i>Science and History</i> 118, 376 <i>Science and Society</i> 150, 280 <i>Science Skill Handbook</i> 788-796
STANDARD 2: Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	
2.1 Students know that matter has characteristic properties, which are related to its composition and structure. As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> examining, describing, measuring, classifying, and predicting common properties of substances (<i>for example, electrical charge, chemical reactivity, acidity, electrical conductivity, radioactivity, relationships in the periodic table</i>); 	SE: 673-678 <i>Applying Math</i> 548 Lab 344-345, 496-497, 680, 778-779 <i>MiniLab</i> 19, 323, 486, 759
<ul style="list-style-type: none"> describing and explaining properties and composition of samples of matter using models (<i>for example, atomic and molecular structure, the periodic table</i>); 	SE: 450-456, 464, 476-480, 512-515, 516-522, 541-545 Lab 457, 466-467 Launch Lab 475 TWE: TC 474
<ul style="list-style-type: none"> separating substances based on their chemical and physical properties (<i>for example, color, solubility, chemical reactivity, melting point, boiling point</i>); and 	SE: 459-461, 737 <i>Applying Science</i> 228, 744 Launch Lab 449 MiniLab 453, 574
<ul style="list-style-type: none"> using word and chemical equations to relate observed changes in matter to its composition and structure. 	SE: 608-614, 632-636, 638-640, 642-643, 649 <i>Applying Math</i> 644 Lab 735 TWE: AS 637
2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed). As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> identifying, measuring, calculating, and analyzing quantitative relationships involved with energy forms (<i>for example, heat transfer in a system involving mass, specific heat, and change in temperature of matter</i>); and 	SE: 158-163, 203-205, 211-213 Lab 180-181, 277, 484 Launch Lab 157 MiniLab 259

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> identifying, measuring, calculating, and analyzing qualitative and quantitative relationships associated with energy transfer or energy transformation (<i>for example, changes in temperature, velocity, potential energy, kinetic energy, conduction, convection, radiation, voltage, current</i>). 	SE: 164-170, 172-179, 203-204, 211-213, 256-257 <i>Lab</i> 171, 180-181, 278-279 <i>Launch Lab</i> 157, 255
2.3 Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged. As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> identifying, describing, and explaining physical and chemical changes involving the conservation of matter and energy (<i>for example, oscillating pendulum/spring, chemical reactions, nuclear reactions</i>); 	SE: 111-113, 465, 632-633 <i>Applying Math</i> 463 <i>Lab</i> 116-117 <i>National Geographic Science and History</i> 110 TWE: DI 635
<ul style="list-style-type: none"> observing, measuring, and calculating quantities to demonstrate conservation of matter and energy in chemical changes (<i>for example, acid-base, precipitation, oxidation-reduction reactions</i>), and physical interactions of matter (<i>for example, force, work, power</i>); 	SE: 134-135, 465, 632-633, 638-639 <i>Integrate Environment</i> 111 TWE: AIL 116 DI 635 LD 110
<ul style="list-style-type: none"> describing and predicting chemical changes (<i>for example, combustion, simple chemical reactions</i>), and physical interactions of matter (<i>for example, velocity, force, work, power</i>), using word or symbolic equations; and 	SE: 128, 131, 135, 632-635, 638-640, 641-643 <i>Applying Math</i> 130, 644 <i>MiniLab</i> 129 TWE: AS 637
<ul style="list-style-type: none"> describing and explaining physical interactions of matter using conceptual models (<i>for example, conservation laws of matter and energy, particle model for gaseous behavior</i>). 	SE: 111-112, 172-174, 200-201, 228-230, 476-479, 490-495, 678-679, 683 <i>National Geographic</i> 110, 140 TWE: IL 113
For students continuing their science education beyond the standards, what they know and are able to do may include	
<ul style="list-style-type: none"> relating their prior knowledge and understanding of properties of matter to observable characteristics of materials and emerging technologies (<i>for example, semiconductors, superconductors, photovoltaics, ceramics</i>); 	SE: 271-276, 585, 739-741, 744-745, 762-763, 767-770 <i>Lab</i> 777 <i>Launch Lab</i> 757
<ul style="list-style-type: none"> modeling quantitative aspects of chemical and physical interactions (<i>for example, rates of reactions, stoichiometry, electromagnetic phenomena, statics and dynamics, electrochemistry</i>); 	SE: 68-70, 86-88, 210-213, 492-495, 638-640, 707-711 <i>Lab</i> 90-91, 148-149, 278-279 <i>MiniLab</i> 129
<ul style="list-style-type: none"> applying knowledge and understanding of chemical and physical interactions to explore factors that influence or govern change (<i>for example, equilibrium constants, kinetics, thermodynamics</i>); and 	SE: 76-77, 174-179, 264-269, 296-301, 476-483, 536-540, 648-650, 668-670, 767-770 <i>Integrate Astronomy</i> 331 <i>Lab</i> 651

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<ul style="list-style-type: none"> distinguishing among different types of constancy (<i>for example, static and dynamic equilibrium, symmetry, uniform/accelerated motion</i>) and different types of change (<i>for example, qualitative and quantitative trends, cyclic change, chaotic systems</i>). 	SE: 41-43, 74, 81-82, 111-112, 310, 476-480 <i>Applying Science</i> 514 <i>Lab</i> 466-467, 652-653, 716-717
STANDARD 5: Students know and understand interrelationships among science, technology, and human activity and how they can affect the world. As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> analyzing benefits, limitations, costs, and consequences involved in using technology or resources (<i>for example, X-rays, agricultural chemicals, natural gas reserves</i>); 	SE: 262-263, 267-269, 745 <i>Integrate History</i> 429, 713 <i>Lab</i> 278-279, 652-653 <i>Science and Society</i> 280, 346, 718
<ul style="list-style-type: none"> analyzing how the introduction of a new technology has affected or could affect human activity (<i>for example, invention of the telescope, applications of modern telecommunications</i>); 	SE: 267-269, 364, 372-373, 398-399 <i>Integrate History</i> 429 <i>Lab</i> 652-653 <i>Science and History</i> 248, 594 <i>Science and Society</i> 440, 780
<ul style="list-style-type: none"> demonstrating the interrelationships between science and technology (<i>for example, building a bridge, designing a better running shoe</i>); and 	SE: 13, 209-213, 762-763 <i>Lab</i> 148-149 <i>National Geographic</i> 2, 555 <i>Science and History</i> 314, 594 <i>Science and Society</i> 150, 780
<ul style="list-style-type: none"> explaining the use of technology in an occupation. 	SE: 736-737, 745 <i>Integrate Career</i> 208, 240, 325, 520, 576, 743 <i>National Geographic</i> 430, 709
For students continuing their science education beyond the standards, what they know and are able to do may include	
<ul style="list-style-type: none"> applying their knowledge and understanding of chemical and physical interactions to explain present and anticipated technologies (<i>for example, lasers, ultrasound, superconducting materials, photocopy machines</i>); and 	SE: 274-276, 331-332, 341-343, 367-373, 396-399, 775-776 <i>Science and History</i> 248, 528, 594 <i>Science and Society</i> 150
<ul style="list-style-type: none"> exploring the scientific and technological aspects of contemporary problems (<i>for example, issues related to nutrition, air quality, natural resources</i>). 	SE: 256-263, 264-269, 271-276, 341-343 <i>Integrate History</i> 713 <i>Lab</i> 344-345, 652-653 <i>Science and Society</i> 280, 346, 718
STANDARD 6: Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines. As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> evaluating print and visual media for scientific evidence, bias, or opinion; 	SE: <i>Lab</i> 652-653 <i>Science and Society</i> 280, 718 TWE: CC 10 DIN 23

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> explaining that the scientific way of knowing uses a critique and consensus process (<i>for example, peer review, openness to criticism, logical arguments, skepticism</i>); 	SE: <i>Communicating Your Data</i> 59, 117, 247, 467, 680, 717 <i>Science and History</i> 118, 560 <i>Science and Society</i> 280 <i>Science Skill Handbook</i> 796
<ul style="list-style-type: none"> using graphs, equations, or other models to analyze systems involving change and constancy (<i>for example, comparing the geologic time scale to shorter time frames</i>); 	SE: 41-44, 48-50, 69-74, 159-162, 262-263, 356, 480, 638-640 <i>Lab</i> 277, 778-779
<ul style="list-style-type: none"> analyzing and comparing models of cyclic change as used within and among scientific disciplines (<i>for example, water cycle, circular motion, sound waves, weather cycles</i>); 	SE: 48, 81-82, 274, 300-301, 354-359, 364, 367-369
<ul style="list-style-type: none"> identifying and predicting cause-effect relationships within a system (<i>for example, the effect of temperature on gas volume, effect of carbon dioxide level on the greenhouse effect, effects of changing nutrients at the base of a food pyramid</i>); 	SE: 83-85, 266, 322-326, 485-487, 490-495, 767-768 <i>Integrate Earth Science</i> 295 <i>MiniLab</i> 361, 711 <i>National Geographic</i> 197
<ul style="list-style-type: none"> identifying and describing the dynamics of natural systems (<i>for example, weather systems, ecological systems, body systems, systems at dynamic equilibrium</i>); 	SE: 45-46, 167, 678-679 <i>Integrate Earth Science</i> 162, 176, 227 <i>Integrate Life Science</i> 179 <i>National Geographic</i> 166, 197, 258, 340
<ul style="list-style-type: none"> identifying and testing a model to analyze systems involving change and constancy (<i>for example, a mathematical expression for gas behavior; constructing a closed ecosystem such as an aquarium</i>); 	SE: <i>Applying Math</i> 40, 102, 162, 463, 493 <i>Lab</i> 106, 277, 484, 496-497, 778-779
<ul style="list-style-type: none"> explaining an exponential model (<i>for example, pH scale, population growth, Richter scale</i>); and 	SE: 262, 492, 704 <i>Applying Math</i> 102, 548 TWE: FYI 703
<ul style="list-style-type: none"> refining a hypothesis based on an accumulation of data over time (<i>for example, Alvarez's theory on dinosaur extinction</i>). 	SE: 509-511, 516-517 <i>Integrate Earth Science</i> 45-46 <i>Lab</i> 652-653 <i>Science and History</i> 118, 376, 560
For students continuing their science education beyond the standards, what they know and are able to do may include	
<ul style="list-style-type: none"> relating small-scale phenomena to large-scale properties (<i>for example, intermolecular forces related to physical properties</i>); and 	SE: 158-159, 164-165, 228-230, 322-323, 476-479, 490-495, 678-679 TWE: FYI 232
<ul style="list-style-type: none"> tracing the development of an invention, theory, or discovery to demonstrate the dynamic nature of science. 	SE: 509-511, 516-517, 634 <i>Accidents in Science</i> 624, 654 <i>National Geographic</i> 2, 769 <i>Science and History</i> 376, 560 <i>Science and Society</i> 780

Codes Used for TWE Pages

A	Activity
AIL	Alternative Inquiry Lab
AS	Assessment
CC	Curriculum Connection
DI	Discussion
DIN	Differentiated Instruction
FYI	Teacher FYI
IL	Inquiry Lab
IN	Investigate
LD	Lab Demonstration
SJ	Science Journal
TC	Theme Connection