



Glencoe

COLORADO
Science Content Standards Grades 9-12
***Chemistry: Matter and Change* © 2005**

STANDARDS	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>MiniLab</i> 230, 439, 604, 848 <i>ChemLab</i> 109 #5, 551 #5 <i>Discovery Lab</i> 385 TWE: A 533 P 614
<ul style="list-style-type: none">creating and defending a written plan of action for a scientific investigation;	SE: <i>Problem-Solving Lab</i> 372, 478, 533 <i>Chapter Assessment</i> 22 #38 <i>Section Assessment</i> 625 #38 <i>ChemLab</i> 627 #1 TWE: A 497, 618, 863 EX 11
<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: <i>ChemLab</i> 480-481, 688-689, 796-797, 832-833, 862-863 <i>Problem-Solving Lab</i> 478 <i>MiniLab</i> 164 TWE: A 497 CJ 620 CU 819
<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>ChemLab</i> 47 #6, 109 #7, 269 #6, 301 #6, 343 #4, 375 #9, 481 #4, 729 #7, 833 #7 TWE: A 504
<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: <i>Problem-Solving Lab</i> 424, 478, 533 <i>MiniLab</i> 573 <i>ChemLab</i> 108-109 <i>Discovery Lab</i> 87 <i>Chapter Assessment</i> 694 #64 TWE: EX 11 A 58 RT 126
<ul style="list-style-type: none">communicating and evaluating scientific thinking that leads to particular conclusions;	SE: <i>Problem-Solving Lab</i> 44, 288, 860 <i>MiniLab</i> 125, 439, 638 <i>Chapter Assessment</i> 734 #85 TWE: A 69, 618, 671

STANDARDS	PAGE REFERENCES
<ul style="list-style-type: none"> recognizing and analyzing alternative explanations and models; and 	SE: <i>Chemistry Online</i> 159 <i>MiniLab</i> 329, 681, 819 <i>ChemLab</i> 109 #6 <i>Chemistry and Technology</i> 344 #2 TWE: DI 599 TS 690 E 99
<ul style="list-style-type: none"> explaining the difference between a scientific theory and a scientific hypothesis. 	SE: 11, 13 <i>Chapter Assessment</i> 22 #33 TWE: IM 12 CU 13
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: <i>ChemLab</i> 627 #1, 833 #1 TWE: CJ 430
<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: <i>Chemistry Online</i> 365, 460, 795 <i>Chemistry and Technology</i> 344 #2, 690 #2 TWE: P 101, 118 CJ 611, 843 BM 825
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: 56-58, 217-220, 228-229, 266 <i>ChemLab</i> 232-233 <i>Problem-Solving Lab</i> 288 <i>MiniLab</i> 125 TWE: EX 400 CJ 620 A 266
<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: <i>MiniLab</i> 401, 819 <i>ChemLab</i> 108-109 <i>Problem-Solving Lab</i> 8 <i>Section Assessment</i> 231 #45 TWE: P 215 DI 189 CU 76 CJ 94 BM 779

STANDARDS	PAGE REFERENCES
<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: 68-69, 725-726 <i>ChemLab</i> 78-79, 268-269 <i>Chemistry Online</i> 69 <i>MiniLab</i> 68 <i>Chapter Assessment</i> 82-83 #47 & #51 <i>Section Assessment</i> 69 #16 & #19 TWE: A 725 CJ 67
<ul style="list-style-type: none"> using word and chemical equations to relate observed changes in matter to its composition and structure. 	SE: 278-280, 501-502, 813-814 <i>MiniLab</i> 295, 638, 786 <i>ChemLab</i> 79 #6 TWE: P 279, 501 EX 814
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: 118-121, 489-500, 666-671, 821-822 <i>Problem-Solving Lab</i> 130 <i>MiniLab</i> 505 TWE: A 497, 671 P 499 EX 11
<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: <i>ChemLab</i> 18-19, 520-521, 688-689, 862-863 <i>Discovery Lab</i> 489 <i>Problem-Solving Lab</i> 503 TWE: QD 490, 501 BM 123
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: 63-65, 490, 821-822 <i>Chapter Assessment</i> 378 #37 TWE: CJ 64 QD 279
<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: 354-356, 821-822 <i>Section Assessment</i> 826 #29 TWE: QD 64 CJ 355 A 363 DI 821
<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: 278-280, 391-392, 460-461, 501-502 <i>Problem-Solving Lab</i> 390, 830 <i>MiniLab</i> 638 TWE: CU 461 P 279, 501

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<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: 385-389, 396-400, 404-408, 455-458 <i>ChemLab</i> 108-109 TWE: IM 426 BM 435 EX 514 A 391 CD 458
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: <i>How It Works</i> 204 <i>Everyday Chemistry</i> 234, 412 <i>Chemistry Online</i> 541 <i>ChemLab</i> 170-171 TWE: AC 399 CD 189 CJ 187 P 57, 225
<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: 358-363, 529-531, 666-671 <i>ChemLab</i> 480-481 <i>MiniLab</i> 819 <i>Problem-Solving Lab</i> 390 TWE: A 360, 531 CU 461 EX 11
<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: 455-461, 536-541, 569-574 <i>ChemLab</i> 410-411, 550-551 TWE: EX 11, 541 QD 537 CJ 538 A 571
<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: 10-11, 118-120, 559-563, 717-721 <i>MiniLab</i> 164, 819 TWE: CJ 12, 119 DI 717 A 719
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: <i>Physics Connection</i> 808 <i>Chemistry and Society</i> 110 <i>Chapter Assessment</i> 526 #102, 838 #100 TWE: P 675, 859 CJ 502, 531 A 492, 510

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<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: 826 <i>Chemistry and Society</i> 20, 110 <i>Chemistry and Technology</i> 344 <i>Everyday Chemistry</i> 730 <i>Chapter Assessment</i> 772 #74 TWE: A 679, 829 AC 161
<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: 17 <i>Chemistry and Technology</i> 344, 446, 588, 690, 768 <i>Chapter Assessment</i> 22 #43 TWE: EX 6, 851 TS 690
<ul style="list-style-type: none"> explaining the use of technology in an occupation. 	SE: <i>Careers Using Chemistry</i> 106, 403, 548, 702, 828 <i>Astronomy Connection</i> 152 <i>Earth Science Connection</i> 408 TWE: P 407 A 818 EX 829
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: <i>How It Works</i> 48, 144, 204, 270, 376, 552 <i>Chemistry Online</i> 122 TWE: BM 825 CD 189 DI 181
<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: 845-849, 853-854, 859-860 <i>Chemistry and Society</i> 80, 834 <i>Problem-Solving Lab</i> 860 <i>MiniLab</i> 848 TWE: A 845, 849 EX 196
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>Chapter Assessment</i> 632 #107 TWE: A 824 CJ 617, 781 P 456
<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: 94-95, 127-130, 152-153 <i>ChemLab</i> 19 #6, 79 #7, 551 #7 <i>MiniLab</i> 68 <i>Section Assessment</i> 13 #13 TWE: EX 89 A 599

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<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: 43-45, 498-500 <i>Problem-Solving Lab</i> 390, 790, 860 <i>ChemLab</i> 520-521, 862-863 TWE: CU 819 CJ 511 A 128
<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: 118-120, 850-851, 858-861 <i>MiniLab</i> 164 <i>Try at Home Labs</i> 954 #5 TWE: P 850 CU 861 QD 120 IM 152 A 164
<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: <i>MiniLab</i> 230, 573, 848 <i>Problem-Solving Lab</i> 219, 390, 860 <i>ChemLab</i> 550-551 TWE: CJ 430 A 372 IM 472
<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: 574, 625, 792-795, 841-854, 858-861 <i>Chemistry Online</i> 460 <i>Problem-Solving Lab</i> 624 TWE: P 850 DI 405 CJ 430
<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>Problem-Solving Lab</i> 130, 314, 533 <i>ChemLab</i> 444-445, 550-551 <i>MiniLab</i> 819 TWE: A 790, 860 AC 428 QD 120
<ul style="list-style-type: none"> explaining an exponential model (<i>for example, pH scale, population growth, Richter scale</i>); and 	SE: 610-611, 817-819 <i>Problem-Solving Lab</i> 830 TWE: A 612, 830
<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: 12-13, 94-97, 127-130, 806 TWE: P 133
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: 228-229, 266, 471-475 <i>Problem-Solving Lab</i> 267 <i>Section Assessment</i> 231 #45 TWE: A 58, 395 VL 228 IM 198 RT 266
<ul style="list-style-type: none"> tracing the development of an invention, theory, or discovery to demonstrate the dynamic nature of science. 	SE: 3-6, 87-97, 127-134, 151-154, 845-846 TWE: P 133, 325 EX 97 CJ 789

Codes Used for TWE pages

A	Assessment
AC	Applying Chemistry
BM	Building a Model
CD	Concept Development
CJ	Chemistry Journal
CU	Check for Understanding
DI	Differentiated Instruction
E	Enrichment
EX	Extension
IM	Identifying Misconceptions
P	Portfolio
QD	Quick Demo
RT	Reteach
TS	Teaching Strategies
VL	Visual Learning