



MINNESOTA
Academic Standards - Science Grades 9-12
Earth Science: Geology, the Environment,
***and the Universe* © 2005**

OBJECTIVES	PAGE REFERENCES
I. HISTORY AND NATURE OF SCIENCE	
A. Scientific World View The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time.	
1. The student will be able to distinguish among hypothesis, theory and law as scientific terms and how they are used to answer a specific question.	SE: 11, 19, 25 #16 <i>Skill Handbook</i> 928-930 TWE: IM 4D TPK 17 CFU 19
2. The student will be able to 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 big bang theory.	SE: 443-447, 448-454, 455-459, 460-463, 557-561, 847-851 TWE: A 447 CFU 447 CD 450 DI 462
3. The student will recognize that in order to be valid, scientific knowledge must meet certain criteria including that it: be consistent with experimental, observational and inferential evidence about nature; follow rules of logic and reporting both methods and procedures; and be falsifiable and open to criticism.	SE: 11-16, 17-19, 756-757 TWE: DI 13 UAA 13 A 19, 626, 634 AC 633 CB 774C
4. The student will explain how traditions of ethics, peer review, conflict and general consensus influence the conduct of science.	SE: 17-19, 468 #5 <i>Science in the News</i> 596 TWE: A 5 CL 446
5. The student will recognize that some scientific ideas are incomplete, and opportunity exists in these areas for new advances.	SE: 462-463, 511-515, 589-591 <i>Science & Technology</i> 354 TWE: CB 358C-D, 373 DI 376 ACT 589

OBJECTIVES	PAGE REFERENCES
B. Scientific Inquiry The student will design and conduct a scientific investigation.	
1. The student will design and complete a scientific experiment using scientific methods by determining a testable question, making a hypothesis, designing a scientific investigation with appropriate controls, analyzing data, making conclusions based on evidence and comparing conclusions to the original hypothesis and prior knowledge.	SE: <i>Design Your Own GeoLab</i> 92-93, 378-379, 676-677, 704-705, 798-799 TWE: P 13, 685 A 71, 163
2. The student will distinguish between qualitative and quantitative data.	SE: <i>Skill Handbook</i> 924
3. The student will apply mathematics and models to analyze data and support conclusions.	SE: <i>Science & Math</i> 206, 380, 644 <i>MiniLab</i> 616 <i>GeoLab</i> 826-827 TWE: P 213, 615 DI 393, 503 ACT 403
4. The student will identify possible sources of error and their effects on results.	SE: <i>GeoLab</i> 140-141, 174-175, 232-233, 826-827 <i>Design Your Own GeoLab</i> 798-799 TWE: CB 15 A 21
5. The student will know that professional scientists and engineers have ethical codes.	TWE: CB 4D
6. The student will give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.	SE: 5-10 TWE: A 49, 386 IM 52D AC 183, 300, 438, 794 ESJ 564
C. Scientific Enterprise The student will understand the relationship between science and technology and how both are used.	
1. The student will compare and contrast the purposes and career opportunities of engineering, technology and science.	SE: <i>Focus On Careers</i> 48, 438, 650, 742, 860 TWE: E 6 CD 502, 609, 882
2. The student will provide an example of a need or problem identified by science and solved by engineering or technology.	SE: 189-190, 312-316 <i>Science & Technology</i> 324 TWE: ACT 319, 722 CD 395 DI 656
3. The student will provide an example of how technology facilitates new discoveries and the development of scientific knowledge.	SE: 37-41, 312-316, 385-387, 747-752 <i>Science & Technology</i> 22, 72, 466 <i>Science in the News</i> 828 TWE: CB 33 DI 109

OBJECTIVES	PAGE REFERENCES
4. The student will know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.	SE: 690-697, 716-723 <i>Science & the Environment</i> 234, 260 <i>Science in the News</i> 294 <i>Science & Technology</i> 354 TWE: AC 193, 218 EC 273 ESJ 631
5. The student will recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.	SE: <i>Science in the News</i> 260 <i>Science & Technology</i> 324, 854 TWE: AC 14, 686 CB 294 ESJ 307 R 377 DI 691
D. Historic Perspectives The student will recognize the historical and cultural context of scientific endeavors and how they influence each other.	
1. The student will be able to trace the development of a scientific advancement, invention or theory and its impact on society.	SE: 443-447, 448-454, 455-459, 460-463, 775-779 TWE: A 391 TPK 455 AC 554, 700 P 753
2. The student will provide examples of scientific advancements contributed by other civilizations and cultures.	TWE: CD 7, 30, 57, 168, 226, 287, 365, 591, 685 CB 384C
3. The student will compare and contrast the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.	SE: 557
III. EARTH AND SPACE SCIENCE	
A. Earth Structure and Processes The student will understand that the interactions of the atmosphere, biosphere, lithosphere, hydrosphere and space have resulted in ongoing change of the Earth system over geologic time.	
1. The student will identify the internal and external sources of energy for the Earth.	SE: 275-277, 578-579 TWE: CB 578 R 579 AES 859
2. The student will apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.	SE: 138-139, 290-291 TWE: CB 147
3. The student will illustrate how biological processes have played significant roles in determining the character of the atmosphere, biosphere, hydrosphere and lithosphere over time.	SE: 7-9, 154-155, 167-168, 584-588 TWE: ITP 7 A 9 DIS 155

OBJECTIVES	PAGE REFERENCES
4. The student will use the theory of plate tectonics to analyze relationships among earthquakes, volcanoes, mountains, fossil deposits, rock layers and ocean features.	SE: 448-454, 455-459, 471-475, 484-487, 509-510 <i>MiniLab</i> 456 <i>Mapping GeoLab</i> 464-465 TWE: AC 457 ITI 485, 509
5. The student will describe how glaciers, gravity, wind, temperature changes, waves and rivers cause weathering and erosion.	SE: 153-161, 162-166, 181-190, 191-197, 198-203, 211-221, 222-227 <i>GeoLab</i> 174-175 <i>Discovery Lab</i> 181 <i>Mapping GeoLab</i> 204-205
6. The student will describe the rock cycle and compare and contrast the processes responsible for the formation of igneous, sedimentary and metamorphic rocks.	SE: 99-106, 107-112, 121-127, 128-132, 133-139 <i>GeoLab</i> 114-115, 140-141 <i>Discovery Lab</i> 121 TWE: A 139 R 149
7. The student will use evidence found in fossils, rock layers, ice cores, radiometric dating and globally gathered data to explain how Earth has changed over short and long periods of time.	SE: 553-556, 557-561, 562-565, 566-569 <i>Discovery Lab</i> 553 <i>MiniLab</i> 558 <i>Problem-Solving Lab</i> 560 TWE: CB 552C-D IM 559 M 559
The student will investigate the impact humans have on the environment.	
1. The student will identify and research an environmental issue and evaluate its impact.	SE: <i>Science & the Environment</i> 176, 234, 706, 736 <i>Science in the News</i> 294 TWE: E 720 P 725, 726, 732 DI 732
B. The Water Cycle, Weather and Climate The student will explain the causes and effects of the Earth's atmospheric and hydrologic processes.	
1. The student will explain how the transfer of energy and motions of the Earth contribute to global climatic processes including wind, waves and ocean currents.	SE: 275-277, 278-284, 299-304, 305-311, 399-405 <i>Discovery Lab</i> 299 TWE: M 276 CFU 277 CB 300 DI 302
2. The student will trace the cyclical movement of carbon and water through the lithosphere, hydrosphere, atmosphere and biosphere.	SE: 211-212, 290-291 <i>MiniLab</i> 290 TWE: A 290 R 291
3. The student will demonstrate the effect of the Earth's tilt, rotation and revolution on the seasons, day length and tides.	SE: 370, 400-403, 758-762 <i>MiniLab</i> 761 TWE: D 758 A 759 M 760 AES 760 ITI 760

OBJECTIVES	PAGE REFERENCES
4. The student will identify, predict and investigate the factors that influence the quality of water and how it can be reused, recycled and conserved.	SE: 669-675, 730-733 <i>Science & the Environment</i> 234, 260 <i>National Geographic</i> 899-901 TWE: CFU 675 E 731 M 731 A 733 ITP 899
5. The student will discuss the impact of the use of natural resources and other human activities on the Earth's climate.	SE: 375-377, 724-729 <i>Science in the News</i> 294 <i>Science & Math</i> 380 <i>Problem-Solving Lab</i> 728 TWE: IM 725 P 725 D 725 ITI 725 A 729
C. The Universe The student will relate the formation and components of our solar system to the conditions necessary for life.	
1. The student will explain how the sun, Earth and solar system formed.	SE: 793-797, 803 #21 <i>GeoDigest</i> 858-859 TWE: CB 576C TPK 793 AC 794 UAA 794 ITI 795 CFU 797
2. The student will compare the characteristics of Earth with the characteristics and movement patterns of the other planets, their satellites and other objects in our solar system.	SE: 780-785, 786-792 <i>GeoDigest</i> 859 TWE: ACT 780 ESJ 782 CFU 785, 861 A 785, 792 R 792
3. The student will compare and contrast the environmental parameters that make life possible on Earth with conditions found on the other planets of our solar system.	SE: 783 TWE: CB 9, 787 EC 783
The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.	
1. The student will identify different types of stars and galaxies and describe how stars, galaxies and the universe change over time.	SE: 805-812, 813-820, 821-825, 833-838, 839-846, 847-851 <i>GeoLab</i> 826-827 TWE: A 825, 837 CL 841
2. The student will explain how nuclear fusion produces energy and other elements.	SE: 809-811, 821-825 TWE: E 811, 823 AC 824

OBJECTIVES	PAGE REFERENCES
3. The student will describe the evidence from current technologies that has been used to understand the composition and the early history of the universe.	SE: 747-752, 847-849 <i>Discovery Lab</i> 775 <i>Science in the News</i> 800, 828 <i>Science & Technology</i> 854 <i>GeoDigest</i> 858 <i>National Geographic</i> 902-907 TWE: AS 907
4. The student will explain how Doppler evidence indicates our universe is expanding in all directions.	SE: 818-819, 843-846 <i>Problem-Solving Lab</i> 843 <i>MiniLab</i> 845 TWE: AC 314 A 843

Codes Used for TWE Pages

A	Assessment
AC	Across the Curriculum
ACT	Activity
AES	Applying Earth Science
AS	Assignment
CB	Content Background
CD	Cultural Diversity
CFU	Check for Understanding
CL	Collaborative Learning
D	Demo
DI	Differentiated Instruction
DIS	Discussion
E	Enrichment
EC	Environmental Connection
ESJ	Earth Science Journal
IM	Identifying Misconceptions
ITI	Interpreting the Illustration
ITP	Interpreting the Photo
M	Modeling
P	Project
R	Reteach
TPK	Tying to Previous Knowledge
UAA	Using an Analogy