



**UTAH**  
**Science – Earth Systems**  
*Earth Science: Geology, the Environment,*  
*and the Universe* © 2005

OBJECTIVES	PAGE REFERENCES
<b>Standard I: Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.</b>	
<b>Objective 1: Describe the big bang theory and evidence supporting it.</b>	
a. Determine the motion of a star relative to Earth based on a red or blue shift in the wavelength of light from the star.	SE: 818-819
b. Explain how evidence of red and blue shifts is used to determine whether the universe is expanding or contracting.	SE: 842-846 <i>Problem-Solving Lab</i> 843 <i>MiniLab</i> 845 TWE: AC 314 A 843, 846
c. Describe the big bang theory and the red shift evidence that supports this theory.	SE: 847-851 <i>Using Math</i> 850 TWE: DI 848 CB 850
d. Investigate and report how science has changed the accepted ideas regarding the nature of the universe throughout history.	SE: 775-779 TWE: CB 774C, 832C AC 842
e. Provide an example of how technology has helped scientists investigate the universe.	SE: 747-752, 753-757 <i>Discovery Lab</i> 775 <i>Science in the News</i> 800, 828 <i>National Geographic</i> 902-907 TWE: P 753, 756
<b>Objective 2: Relate the structure and composition of the solar system to the processes that exist in the universe.</b>	
a. Compare the elements formed in the big bang (hydrogen, helium) with elements formed through nuclear fusion in stars.	SE: 809-810, 821-825 <i>Science &amp; Technology</i> 854 TWE: E 823 CB 849 TS 854
b. Relate the life cycle of stars of various masses to the relative mass of elements produced.	SE: 821-825 TWE: DI 822 AC 824 R 861
c. Explain the origin of the heavy elements on Earth (i.e., heavy elements were formed by fusion in ancient stars).	SE: 794-795 TWE: AC 824

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d. Present evidence that the process that formed Earth's heavy elements continues in stars today.	SE: 809-810, 821-825 TWE: AC 824
e. Compare the life cycle of the sun to the life cycle of other stars.	SE: 821-825 TWE: A 825
f. Relate the structure of the solar system to the forces acting upon it.	SE: 775-779, 793-797 TWE: AC 794 D 778 A 779
<b>Standard II: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.</b>	
<b>Objective 1:</b> Describe the unique physical features of Earth's environment that make life on Earth possible.	
a. Compare Earth's atmosphere, solar energy, and water to those of other planets and moons in the solar system.	SE: 780-785, 786-792 TWE: AC 585, 787 CB 782 ESJ 782 EC 783 A 784 TPK 787
b. Compare the conditions that currently support life on Earth to the conditions that exist on other planets in the solar system.	SE: 783 TWE: CB 9, 787 E 389
c. Evaluate evidence for existence of life in other star systems, planets, or moons, either now or in the past.	SE: <i>Science in the News</i> 596 TWE: CB 9, 774C, 787
<b>Objective 2:</b> Analyze how ecosystems differ from each other due to abiotic and biotic factors.	
a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.	SE: <i>Science &amp; the Environment</i> 432 TWE: CB 412D
b. Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).	SE: <i>Science &amp; the Environment</i> 432 TWE: CB 412D TS 432 A 439 E 712
c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.	SE: <i>Problem-Solving Lab</i> 637, 665 TWE: A 611 M 660 DI 713
d. Explain that energy enters the vast majority of Earth's ecosystems through photosynthesis, and compare the path of energy through two different ecosystems.	SE: 664, 683-684 <i>Activity</i> 432 TWE: TPK 628
e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).	SE: 711-715 TWE: CB 412D, 720 A 439 AC 720 ACT 727

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f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.	TWE: P 727
<b>Objective 3: Examine Earth's diversity of life as it changes over time.</b>	
a. Observe and chart the diversity in a specific area.	TWE: DI 718
b. Compare the diversity of life in various biomes specific to number of species, biomass, and type of organisms.	TWE: CB 412D DI 718
c. Explain factors that contribute to the extinction of a species.	SE: 610-611, 616-617, 633-634 <i>Science in the News</i> 572 <i>Section Assessment</i> 617 <i>Science &amp; the Environment</i> 620 <i>Earth Science Online</i> 634 TWE: A 611 CFU 617 CB 633
d. Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.	SE: <i>Earth Science Online</i> 611 <i>Science &amp; the Environment</i> 620
e. Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.	SE: 718 <i>Science &amp; the Environment</i> 234, 706 TWE: TS 380, 706 CB 706
<b>Standard III: Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.</b>	
<b>Objective 1: Explain the evidence that supports the theory of plate tectonics.</b>	
a. Define and describe the location of the major plates and plate boundaries.	SE: 455-459 TWE: R 459
b. Compare the movement and results of movement along convergent, divergent, and transform plate boundaries.	SE: 455-459, 460-463 <i>Problem-Solving Lab</i> 458 TWE: ITI 455
c. Relate the location of earthquakes and volcanoes to plate boundaries.	SE: 455-459, 471-475, 484-487, 509-510 <i>GeoLab</i> 516-517 TWE: ITI 485, 509 R 549
d. Explain Alfred Wegener's continental drift hypothesis, his evidence, and why it was not accepted in his time.	SE: 443-447 TWE: CB 442C CL 446 M 446 A 447 CFU 447 R 447
e. Evaluate the evidence for the current theory of plate tectonics.	SE: 448-454, 455-459, 460-463 TWE: CD 450 D 451 DI 462

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<b>Objective 2:</b> Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	
a. Identify the energy sources that cause material to move within Earth.	SE: 460-463, 578-579 TWE: ITI 461 CFU 463 CB 581 AES 859
b. Model the movement of materials within Earth.	SE: <i>Discovery Lab</i> 471, 495 TWE: D 460 IM 461 CB 581
c. Model the movement and interaction of plates.	SE: <i>Discovery Lab</i> 443 <i>MiniLab</i> 456 <i>Mapping GeoLab</i> 464-465 TWE: IM 444 DI 445, 457 M 452 A 459 E 462 SF 546
d. Relate the movement and interaction of plates to volcanic eruptions, mountain building, and climate changes.	SE: 455-459, 484-487, 509-510, 528-534, 535-539 <i>Science &amp; the Environment</i> 490 TWE: AC 457 ITI 509 TPK 531 CFU 534
e. Predict the effects of plate movement on other Earth systems (e.g., volcanic eruptions affect weather, mountain building diverts waterways, uplift changes elevation that alters plant and animal diversity, upwelling from ocean vents results in changes in biomass).	SE: 511-515 <i>Internet GeoLab</i> 488-489 <i>Science &amp; the Environment</i> 490 TWE: CFU 487 CB 490 ESJ 513 EC 514 TPK 533
<b>Standard IV: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.</b>	
<b>Objective 1:</b> Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	
a. Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally, and graph or chart relative amounts in global reservoirs.	SE: 211-221, 228-231, 239-243, 290-291 TWE: IM 212 A 219 AC 240 CB 240, 270D DIS 242
b. Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.	SE: 211-221, 222-227, 239-243, 290-291 <i>GeoLab</i> 232-233 <i>MiniLab</i> 290 TWE: A 218, 240 M 240 R 257

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c. Relate the physical and chemical properties of water to a water pollution issue.	SE: 228-231, 254-257, 669-675, 730-733 <i>Mapping GeoLab</i> 734-735 TWE: EC 216 AC 255 D 731 DI 732
d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.	SE: <i>MiniLab</i> 674 TWE: TS 234 CFU 267 ACT 727 E 731 EC 732 P 732
e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.	SE: 730-733 <i>Science &amp; the Environment</i> 234 <i>Design Your Own GeoLab</i> 676-677 TWE: AC 218, 671 CFU 733
<b>Objective 2: Analyze the physical and biological dynamics of the oceans.</b>	
a. Describe the physical dynamics of the oceans (e.g., wave action, ocean currents, El Nino, tides).	SE: 370-371, 399-405, 764 <i>Earth Science Online</i> 400 <i>Problem-Solving Lab</i> 401 TWE: CB 384C-D, 400 D 400 ESJ 404 R 404
b. Determine how physical properties of oceans affect organisms (e.g., salinity, depth, tides, temperature).	SE: 392-398 TWE: CON 370 P 371 ITI 396 AC 403
c. Model energy flow in ocean ecosystems.	SE: <i>Activity</i> 432 TWE: P 371
d. Research and report on changing ocean levels over geologic time, and relate changes in ocean level to changes in the water cycle.	SE: 603-604, 605-606, 612-614, 635 TWE: IM 603 A 604 R 604
e. Describe how changing sea levels could affect life on Earth.	SE: 376, 617 <i>Problem-Solving Lab</i> 636 TWE: A 616
<b>Standard V: Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.</b>	
<b>Objective 1: Describe how matter in the atmosphere cycles through other Earth systems.</b>	
a. Trace movement of a carbon atom from the atmosphere through a plant, animal, and decomposer, and back into the atmosphere.	These references describe the relationship between photosynthetic organisms and the carbon cycle. SE: 375-377, 664

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b. Diagram the nitrogen cycle and provide examples of human actions that affect this cycle (e.g., fertilizers, crop rotation, fossil fuel combustion).	SE: 665 TWE: AC 720
c. Interpret evidence suggesting that humans are influencing the carbon cycle.	SE: 375-377, 664, 725 <i>Science &amp; Math</i> 380
d. Research ways the biosphere, hydrosphere, and lithosphere interact with the atmosphere (e.g., volcanic eruptions putting ash and gases into the atmosphere, hurricanes, changes in vegetation).	SE: 341-345, 369-374 <i>Science &amp; the Environment</i> 490 TWE: CB 298C, 358C-D, 490 ITI 369 M 373 A 374
<b>Objective 2:</b> Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	
a. Define ozone and compare its effects in the lower and upper atmosphere.	SE: 273, 724-726 <i>Science in the News</i> 294 <i>Earth Science Online</i> 588
b. Describe the role of living organisms in producing the ozone layer and how the ozone layer affected the development of life on Earth.	SE: 584-588, 664 TWE: E 65 CB 576C-D
c. Compare the rate at which CO <sub>2</sub> is put into the atmosphere to the rate at which it is removed through the carbon cycle.	SE: <i>Science &amp; Math</i> 380
d. Analyze data relating to the concentration of atmospheric CO <sub>2</sub> over the past 100 years.	SE: 725-726 <i>Science &amp; Math</i> 380 TWE: CB 585 ITI 725
e. Research, evaluate, and report on international efforts to protect the atmosphere.	SE: 728-729 <i>Science in the News</i> 294 TWE: R 377, 729
<b>Standard VI: Students will understand the source and distribution of energy on Earth and its effects on Earth systems.</b>	
<b>Objective 1:</b> Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	
a. Illustrate the distribution of energy coming from the sun that is reflected, changed into heat, or stored by plants.	SE: 275-277 TWE: M 276 CFU 277 ACT 282
b. Describe the pathways for converting and storing light energy as chemical energy (e.g., light energy converted to chemical energy stored in plants, plants become fossil fuel).	SE: 683-689

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c. Investigate the conversion of light energy from the sun into heat energy by various Earth materials.	SE: 275-277 TWE: ACT 275 A 276 M 276 UAA 276 TPK 278 D 281 DI 302
d. Demonstrate how absorbed solar energy eventually leaves the Earth system as heat radiating to space.	SE: 275 TWE: ACT 282
e. Construct a model that demonstrates the reduction of heat loss due to a greenhouse effect.	SE: 375 <i>MiniLab</i> 376 TWE: D 725
f. Research global changes and relate them to Earth systems (e.g., global warming, solar fluctuations).	SE: 369-374, 375-377 TWE: E 370 CON 371 DI 371, 376 AC 372 IM 372 A 373, 377
<b>Objective 2: Relate energy sources and transformation to the effects on Earth systems.</b>	
a. Describe the difference between climate and weather, and how technology is used to monitor changes in each.	SE: 300, 312-316, 317-321 <i>Science &amp; Technology</i> 324 TWE: ESJ 290 P 314 CL 315 CFU 316 ACT 319 CB 358C
b. Describe the effect of solar energy on the determination of climate and weather (e.g., El Nino, solar intensity).	SE: 300-304, 361-363, 364-368, 370, 759-762 <i>MiniLab</i> 302, 761 TWE: DIS 366 CON 437 ITI 760
c. Explain how uneven heating at the equator and polar regions creates atmospheric and oceanic convection currents that move heat energy around Earth.	SE: 300-304, 305-311, 403-404 <i>Section Assessment</i> 311 TWE: CB 300 CFU 405
d. Describe the Coriolis effect and its role in global wind and ocean current patterns.	SE: 305, 404 TWE: CON 343 A 405 R 405
e. Relate how weather patterns are the result of interactions among ocean currents, air currents, and topography.	SE: 285-286, 299-304, 305-311, 329-333, 334-340, 341-346, 347-351 TWE: CON 330 R 346 SF 436

## Codes Used for TWE Pages

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