

# SCIENCE

# SC 33 Earth Science

Course #: SC-33	Grade Level: 10 - 12
Course Name: Earth Science	Level of Difficulty: Average
Prerequisites: None	# of Credits: 1-

## Strand 1: Inquiry Process

*“Science as inquiry is basic to science education and a controlling principle in the continuing organization and selection of students’ activities. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry...”* (National Science Education Standards, 1995).

Inquiry Process establishes the basis for students’ learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results.

## Concepts

### Concept 1: Observations, Questions, and Hypotheses

- Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

### Concept 2: Scientific Testing (Investigating and Modeling)

- Design and conduct controlled investigations.

### Concept 3: Analysis, Conclusions, and Refinements

- Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

### Concept 4: Communication

- Communicate results of investigations.

## Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C1	Observations, Questions, and Hypotheses	1	Evaluate scientific information for relevance to a given problem.		Evidence for Plate Tectonics
		2	Develop questions from observations that transition into testable hypotheses.		
		3	Formulate a testable hypothesis.		
		4	Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C2	Scientific Testing (Investigating and Modeling)	1	Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, and organisms) and behavior in all science inquiry.		
		2	Identify the resources needed to conduct an investigation.		
		3	Design an appropriate protocol (written plan of action) for testing a hypothesis: <ul style="list-style-type: none"> <li>▪ Identify dependent and independent variables in a controlled investigation.</li> <li>▪ Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).</li> <li>▪ Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).</li> </ul>		
		4	Conduct a scientific investigation that is based on a research design.		
		5	Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C3	Analysis and Conclusions, and Refinements	1	<i>Interpret data that show a variety of possible relationships between variables, including:</i> <ul style="list-style-type: none"> <li>▪ <i>positive relationship</i></li> <li>▪ <i>negative relationship</i></li> <li>▪ <i>no relationship</i></li> </ul>		
		2	Evaluate whether investigational data support or do not support the proposed hypothesis.		
		5	Design models (conceptual or physical) of the following to represent "real world" scenarios. <ul style="list-style-type: none"> <li>▪ carbon cycle</li> <li>▪ water cycle</li> <li>▪ phase change</li> <li>▪ collisions</li> </ul>		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C4	Communication	1	<b>For a specific investigation, choose an appropriate method for communicating the results.</b>		
		2	<b>Produce graphs that help communicate data. (See MHS-S2C1-02)</b>		
		3	<b>Communicate results clearly and logically.</b>		
		4	<b>Support conclusions with logical scientific arguments.</b>		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

**Strand 2: History and Nature of Science**

*Knowledge of the nature of science is central to the understanding of the scientific enterprise” (National Assessment of Educational Progress, 2000).*

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists play in the development of various cultures.

- Concepts**
- Concept 1: History of Science as a Human Endeavor**
- Identify individual, cultural, and technological contributions to scientific knowledge.
- Concept 2: Nature of Scientific Knowledge**
- Understand how science is a process for generating knowledge.

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S2C1	History of Science as a Human Endeavor	1	Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.		
		2	<i>Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.</i>		Astronomy
		3	Analyze how specific changes in science have affected society.		Astronomy
		4	Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.		Astronomy
S2C2	Nature of Scientific Knowledge	2	Explain the process by which accepted ideas are challenged or extended by scientific innovation.		Astronomy Plate Tectonics
		4	Describe how scientists continue to investigate and critically analyze aspects of theories.		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

**Strand 3: Science in Personal and Social Perspectives**

Science in Personal and Social Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, and the ways people are involved in both. Students understand the impact of science and technology on human activity and the environment. This strand affords students the opportunity to understand their place in the world – as living creatures, consumers, decision makers, problem solvers, managers, and planners.

**Concepts**

**Concept 1: Changes in Environments**

- Describe the interactions between human populations, natural hazards, and the environment.

**Concept 2: Science and Technology in Society**

- Develop viable solutions to a need or problem.

**Concept 3: Human Population Characteristics**

- Analyze factors that affect human populations.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C1	Changes in Environments	1	Evaluate how the processes of natural ecosystems affect, and are affected by, humans.		Greenhouse & Global warming
		2	Describe the environmental effects of the following natural and/or human-caused hazards: <ul style="list-style-type: none"> <li>▪ flooding</li> <li>▪ drought</li> <li>▪ earthquakes</li> <li>▪ fires</li> <li>▪ pollution</li> <li>▪ extreme weather</li> </ul>		
		3	Assess how human activities (e.g., clear cutting, water management, tree thinning) can affect the potential for hazards.		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

**SCIENCE**

**SC 33 Earth Science**

<b>Students should know and be able to...</b>					
<b>Concept Number</b>	<b>Concept</b>	<b>PO No.</b>	<b>Performance Objective</b>	<b>Vocabulary</b>	<b>Notes/Integration/Resources</b>
S3C1 (cont.)		4	Evaluate the following factors that affect the quality of the environment: <ul style="list-style-type: none"> <li>▪ urban development</li> <li>▪ smoke</li> <li>▪ volcanic dust</li> </ul>		
		5	Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality and biodiversity.		
S3C2	Science and Technology in Society	1	Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems: <ul style="list-style-type: none"> <li>▪ various forms of alternative energy</li> <li>▪ storage of nuclear waste</li> <li>▪ abandoned mines</li> <li>▪ greenhouse gases</li> <li>▪ hazardous wastes</li> </ul>		
		2	Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.		
		3	Support a position on a science or technology issue.		
		4	Analyze the use of renewable and nonrenewable resources in Arizona: <ul style="list-style-type: none"> <li>▪ water</li> <li>▪ land</li> <li>▪ soil</li> <li>▪ minerals</li> <li>▪ air</li> </ul>		
		5	Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C3	Human Population Characteristics	1	Analyze social factors that limit the growth of a human population, including: <ul style="list-style-type: none"> <li>▪ affluence</li> <li>▪ education</li> <li>▪ access to health care</li> <li>▪ cultural influences</li> </ul>		
		2	Describe biotic (living) and abiotic (nonliving) factors that affect human populations.		
		3	Predict the effect of a change in a specific factor on a human population.		

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

**Strand 6: Earth and Space Science**

*“Earth science is the study of the planets, Earth’s composition, processes, environments and history, focusing on the solid Earth, and its interaction with air and water” (NAEP 2000).*

Earth and Space Science provides the foundation for students to develop an understanding of the Earth, its history, composition, and formative processes, the solar system, and the universe. Students study the regularities of the interrelated systems of the natural world. In doing so, they develop understandings of the basic laws, theories, and models that explain the world (NSES, 1995). By studying the Earth from both a historical and current time frame, students can make informed decisions about issues affecting the planet on which they live.

**Concepts**

**Concept 1: Geochemical Cycles**

- Analyze the interactions between the Earth’s structures, atmosphere, and geochemical cycles.

**Concept 2: Energy in the Earth System (Both Internal and External)**

- Understand the relationships between the Earth’s land masses, oceans, and atmosphere.

**Concept 3: Origin and Evolution of the Earth System**

- Analyze the factors used to explain the history and evolution of the Earth.

**Concept 4: Origin and Evolution of the Universe**

- Analyze the factors used to explain the origin and evolution of the universe.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/ Resources
S6C1	Geochemical Cycles	1	Identify ways materials are cycled within the earth system (i.e., carbon cycle, water cycle, rock cycle).	Coal, limestone, petroleum, carbon dioxide	Diagram these three cycles.
		2	Demonstrate how dynamic processes such as weathering, erosion, sedimentation, metamorphism, and orogenesis relate to redistribution of materials within the earth system.		
		3	Explain how the rock cycle is related to plate tectonics.	Igneous, sedimentary, metamorphic	Key out minerals. Classify and identify rocks.

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C1 (cont.)		4	<b>Demonstrate how the hydrosphere links the biosphere, lithosphere, cryosphere, and atmosphere.</b>	Evaporation, condensation, sublimation, deposition	
		5	<b>Describe factors that impact current and future water quantity and quality including surface, ground, and local water issues.</b>	Water table, aquifer, permeability	

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C2	Energy in the Earth System (Both Internal and External)	1	Describe the flow of energy to and from the Earth.	Radiation, solar wind	
		2	Explain the mechanisms of heat transfer (convection, conduction, radiation) among the atmosphere, land masses, and oceans.	Density	D=m/v
		3	Distinguish between weather and climate.	Relative humidity, dew point	What causes seasons?
			<b>Internal Energy:</b>		
		4	Demonstrate the relationship between the Earth's internal convective heat flow and plate tectonics.	Asthenosphere, convergent, divergent	Diagram convection and give its causes.
		5	Demonstrate the relationships among earthquakes, volcanoes, mountain ranges, mid-oceanic ridges, deep sea trenches, and tectonic plates.	Subduction, sea-floor spreading, transform faulting	Describe all types of plate boundaries.
		6	Distinguish among seismic S, P, and surface waves.	Compression, shear	Find epicenter of earthquake.
		7	Analyze the seismic evidence (S and P waves) used to determine the structure of the Earth.	Inner and outer core, mantle, lithosphere	Explain shadow zone.
			<b>External Energy:</b>		
		9	Explain the effect of heat transfer on climate and weather.	High pressure belts, low pressure belts, coriolis, monsoon	Draw diagram of pressure belts and prevailing winds.
		10	Demonstrate the effect of the Earth's rotation (i.e., Coriolis effect) on the movement of water and air.	Trade winds, horse latitudes, doldrums	(11)

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C2 (cont.)		11	<b>Describe the origin, life cycle, and behavior of weather systems (i.e., air mass, front, high and low systems, pressure gradients).</b>	Barometer pressure, density	Explain wind. Diagram winds around highs and lows.
		12	<b>Describe the conditions that cause severe weather (e.g., hurricanes, tornadoes, thunderstorms).</b>	Cold front, warm front	
		14	<b>Analyze how weather is influenced by both natural and artificial earth features (e.g., mountain ranges, bodies of water, cities, air pollution).</b>	Rain shadow	
		15	<b>List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).</b>		Explain conditions that cause rain.

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C3	Origin and Evolution of the Earth System		<b>Earth Origin/system:</b>		
		1	<b>Describe the scientific theory of the origin of the solar system (solar nebular hypothesis).</b>	Gravity, compression	
		2	<b>Describe the characteristics, location, and motions of the various kinds of objects in our solar system, including the Sun, planets, satellites, comets, meteors, and asteroids.</b>		Explain seasonal constellations.
		3	<b>Explain the phases of the Moon, eclipses (lunar and solar), and the interaction of the Sun, Moon, and Earth (tidal effect).</b>	Crescent, gibbons, new full quarter, spring and neap tides, umbra, perihelion, athelion, perigee, apagee	
			<b>Earth History/Evolution:</b>		
		5	<b>Distinguish between relative and absolute geologic dating techniques.</b>	Index fossil, half life	Use stratigraphic rules to determine historic sequence.
		7	<b>Describe how life on Earth has influenced the evolution of the Earth's systems.</b>	Photosynthesis	Discuss evolution of the atmosphere.
		8	<b>Sequence major events in the Earth's evolution (e.g., mass extinctions, glacial episodes) using relative and absolute dating data</b>	Giant impact theories	
S6C4	Origin and Evolution of the Universe	1	<b>Describe the Big Bang Theory as an explanation for the origin of the universe.</b>	Gravity, F & G $\frac{M_1 & M_2}{d^2}$	Doppler
		2	<b>Describe the fusion process that takes place in stars.</b>		$E=mc^2$

Plain text denotes Mesa Public Schools guidelines and/or performance objective.

**Bold text denotes exact wording and punctuation from the Arizona Academic Content Standard.** The bulleted items with a performance objective indicate specific content to be taught.

*Italics denote a repetition of a performance objective (learned in an earlier grade) that is to be applied to grade level content or at a higher level of complexity.*