

**Course Description:**

The first three modules of Semester 2 cover the physical structure of the Earth and Earth’s tectonic system, including the rock cycle, tectonic activity, and mountain building. It then covers weathering and erosion and soil formation. The next material in the course then addresses the concept of systems; it addresses the Earth as a system, feedback in systems, and Earth’s major nutrient cycles. The second three modules of Semester 2 cover geologic history, including the evolution of Earth’s atmosphere, the geologic time scale, and the fossil record. It then goes over natural resources and the effects of human population on natural resources. The course wraps up with a discussion of human society and its interconnectedness with the Earth’s environment, how science and technology work together, and the technological design process in earth science applications.

**Materials Needed:**

- uninflated round balloon
- permanent marker
- 50 small candies that have letters on one side of them (like M&Ms or Skittles)
- a small zipper seal plastic bag
- two kitchen mixing bowls
- ice cubes
- water
- a permanent marker
- a block of wood
- a pair of pliers
- a pair of needle-nose tweezers
- a slotted spoon
- a drinking straw
- sunflower seeds in the shell
- colored water
- a long narrow vase
- rice grains
- small block of Styrofoam
- 3 or 4 large marshmallows
- a teaspoon of herbs (any kind will do, like basil or parsley)

Module	Lesson Title	Objectives
<i>Earth</i>	The Structure of the Earth	<ul style="list-style-type: none"> <li>• Describe and illustrate the layers of the Earth.</li> <li>• Explain how scientists know about the interior of the Earth.</li> </ul>

Module	Lesson Title	Objectives	Lesson Title
		<ul style="list-style-type: none"> <li>Describe how the core creates Earth's magnetic field.</li> </ul>	
	The Rock Cycle	<ul style="list-style-type: none"> <li>Define rock and mineral and describe the difference between the two.</li> <li>Describe the features of the three main types of rocks, including how each one is formed.</li> <li>Illustrate and explain the rock cycle.</li> <li>Give examples of how people use different types of rocks.</li> </ul>	
	Plate Tectonics	<ul style="list-style-type: none"> <li>Describe the history of plate tectonic theory.</li> <li>Explain the theory of plate tectonics.</li> <li>Describe the three type of plate movement: transform, convergent, divergent.</li> <li>Cite evidence for plate tectonic movement.</li> <li>Explain the connection between plate tectonics and movements of the ocean floor.</li> </ul>	
	Volcanoes	<ul style="list-style-type: none"> <li>Describe the connection between plate tectonics and volcanic activity.</li> <li>Explain how hot-spots and plate tectonics create volcanic island chains.</li> <li>Describe the three major types of volcanoes.</li> <li>Describe the process of how volcanic gases become explosive.</li> </ul>	

Module	Lesson Title	Objectives
		<ul style="list-style-type: none"> <li>Describe why volcanoes with different types of magma have different levels of explosivity, i.e., silica-rich magma vs. basalt-rich magma.</li> <li>Describe the origin and characteristics of volcanic materials such as cinder, ash, and lava.</li> </ul>
	Earthquakes	<ul style="list-style-type: none"> <li>Explain what causes earthquakes.</li> <li>Describe the different types of earthquake waves and how they move through the Earth.</li> <li>Describe earthquake activity in the context of the theory of plate tectonics.</li> <li>Explain how scientists predict earthquake activity.</li> </ul>
	Mountains and Ocean Ridges	<ul style="list-style-type: none"> <li>Explain the formation of mountains in the context of the theory of plate tectonics.</li> <li>Describe how fault block and folded mountains are formed.</li> <li>Describe how ocean ridges and ocean trenches are formed.</li> </ul>
	Weathering	<ul style="list-style-type: none"> <li>Define weathering.</li> <li>Describe the processes involved in the different types of weathering: biological, chemical, physical.</li> <li>Describe the basic chemical and physical properties of soil.</li> </ul>
	Soil	<ul style="list-style-type: none"> <li>Define soil and explain how soil is formed, including its connection to the processes of weathering.</li> </ul>

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		<ul style="list-style-type: none"> <li>• Explain how soil is an important natural resource.</li> </ul>
	Erosion	<ul style="list-style-type: none"> <li>• Define soil erosion.</li> <li>• Explain why soil erosion is a problem.</li> <li>• Describe the forces that affect soil erosion, including natural and human activity.</li> <li>• Present ideas for how to prevent soil erosion.</li> </ul>
	<b>Earth Module Exam</b>	
<b><i>Systems and Cycles</i></b>	Systems	<ul style="list-style-type: none"> <li>• Define and give examples of systems.</li> <li>• Explain how systems thinking can be used to investigate complex situations or -----</li> <li>• Use a systems diagram to illustrate components, boundaries and flows.</li> <li>• Describe how systems can be changing or in equilibrium.</li> </ul>
	The Earth as a System	<ul style="list-style-type: none"> <li>• Explain how the Earth as a whole is a system.</li> <li>• Give examples of systems on Earth, such as the water-atmosphere system, etc.</li> </ul>
	Feedback in Systems	<ul style="list-style-type: none"> <li>• Explain what is meant by system feedback.</li> <li>• Give examples of a positive feedback system and the mechanisms that regulate it (e.g., global warming causes earth's ice</li> </ul>

Module	Lesson Title	Objectives
		<p>caps to melt, reflecting less energy to space, increasing temperature).</p> <ul style="list-style-type: none"> <li>• Give examples of a negative feedback system and the mechanism that regulates it.</li> </ul>
	The Oxygen Cycle	<ul style="list-style-type: none"> <li>• Describe and illustrate Earth's oxygen cycle.</li> <li>• Explain the significance of the oxygen cycle in supporting life on earth.</li> </ul>
	The Carbon Cycle	<ul style="list-style-type: none"> <li>• Describe and illustrate Earth's carbon cycle, including how energy from the sun drives Earth's carbon cycle.</li> <li>• Describe the different forms taken by carbon and the reservoirs where they are found.</li> <li>• Give examples of carbon forms found on Earth.</li> </ul>
	The Nitrogen Cycle	<ul style="list-style-type: none"> <li>• Describe and illustrate Earth's nitrogen cycle.</li> <li>• Explain the role of microorganisms in Earth's nitrogen cycle.</li> <li>• Explain the significance of the nitrogen cycle to life on Earth.</li> <li>• Explain how the Haber-Bosch process has affected the natural nitrogen cycle.</li> </ul>
	<b>Systems and Cycles Module Exam</b>	

Module	Lesson Title	Objectives
<i>Earth's Past</i>	Evidence for an Ancient Earth	<ul style="list-style-type: none"> <li>• Cite evidence that the earth is 4.65 billion years old.</li> <li>• Explain how scientists study the history of the earth and its age.</li> </ul>
	Evolution of the Atmosphere	<ul style="list-style-type: none"> <li>• Describe the formation and evolution of earth's atmosphere.</li> <li>• Cite evidence that the atmosphere has changed through time.</li> <li>• Compare the chemical composition of the atmosphere before bacteria and plants evolved and after they became widespread.</li> </ul>
	Rock Formations	<ul style="list-style-type: none"> <li>• Describe how rock formations were formed.</li> <li>• Describe geologic events that may have created given rock formations, e.g., erosion, glaciation, deposition, etc.</li> <li>• Construct a timeline of events for the development of a rock formation, given how it was formed.</li> </ul>
	The Fossil Record	<ul style="list-style-type: none"> <li>• Define fossil and explain how fossils are formed.</li> <li>• Describe how the fossil record is used to study earth's past.</li> <li>• Explain how fossils can be used in relative dating.</li> </ul>
	<b>Earth's Past Module Exam</b>	

Module	Lesson Title	Objectives
<b><i>The Geologic Time Scale</i></b>	Structure of the Geologic Time Scale	<ul style="list-style-type: none"> <li>Describe the units and divisions of the geologic time scale.</li> <li>Explain how the decay rates of radioactive materials are used to establish the timing of geologic events.</li> </ul>
	The Precambrian	<ul style="list-style-type: none"> <li>Describe the earth conditions and life forms of the Precambrian.</li> </ul>
	The Paleozoic	<ul style="list-style-type: none"> <li>Describe the conditions and major life forms of Earth during the Paleozoic Era.</li> </ul>
	The Mesozoic	<ul style="list-style-type: none"> <li>Describe the earth conditions and life forms of the Mesozoic Era.</li> </ul>
	The Cenozoic	<ul style="list-style-type: none"> <li>Describe the earth conditions and life forms of the Cenozoic Era.</li> </ul>
	<b>The Geologic Time Scale Module Exam</b>	
<b><i>Natural Resources</i></b>	Non-renewable Energy	<ul style="list-style-type: none"> <li>Describe the various types of non-renewable fuels humans use for energy.</li> <li>Explain some of the environmental issues associated with the use of non-renewable energy sources.</li> <li>Suggest solutions to resource scarcity and other environmental concerns associated with non-renewable energy.</li> </ul>

Module	Lesson Title	Objectives
	Renewable Energy	<ul style="list-style-type: none"> <li>• Describe the various kinds of renewable fuels that humans use for energy.</li> <li>• Describe the advantages and disadvantages of renewable energy.</li> <li>• Describe where renewable energy resources can be used.</li> </ul>
	Air Pollution	<ul style="list-style-type: none"> <li>• Explain the natural and anthropogenic causes of air pollution.</li> <li>• Explain the effects of air pollution.</li> <li>• Explain the cause and effect of ozone depletion and of smog formation.</li> <li>• Explain what greenhouse gases are.</li> <li>• Suggest ways that society can address air pollution problems.</li> </ul>
	Climate Change	<ul style="list-style-type: none"> <li>• Outline the history of climate on earth.</li> <li>• Explain what is meant by global climate change and describe the factors that affect it.</li> <li>• Cite evidence that the earth is undergoing a period of human-induced climate change.</li> <li>• Describe the effects of global climate change on people, cultures, and the environment.</li> </ul>
	Biodiversity and Habitat Loss	<ul style="list-style-type: none"> <li>• Define biodiversity and explain why it is important.</li> <li>• Describe the environmental issue of habitat destruction.</li> </ul>
	<b>Natural Resources Module Exam</b>	



Module	Lesson Title	Objectives
<b><i>Humans and the Earth</i></b>	Brief History of Humanity	<p>Describe a brief history of humanity.                      Be able to connect advancements in technology and agriculture to increases in human population.</p> <ul style="list-style-type: none"> <li>• Understand how increases in population can affect civilization.</li> </ul>
	Human Population	<ul style="list-style-type: none"> <li>• Discuss the issue of population and its relationship to natural resources.</li> </ul>
	Urbanization	<ul style="list-style-type: none"> <li>• Describe current trends in urbanization.</li> <li>• Explain how urbanization affects land and water resources.</li> </ul>
	Science Professions	<ul style="list-style-type: none"> <li>• Explain how to prepare for a career in science.</li> </ul>
	How Science and Technology Work Together	<ul style="list-style-type: none"> <li>• Be able to conceptualize how science and technology work together to achieve scientific goals.</li> </ul>
	Technological Design Process	<ul style="list-style-type: none"> <li>• Explain the technological design process. Describe a current technological design endeavor within the earth science disciplines.</li> <li>• Discuss the idea of tradeoffs in technological solutions to problems.</li> </ul>
	<b>Humans and the Earth Module Exam</b>	
<b>Semester Exam</b>		