

## EARTH AND SPACE SCIENCES ALTERNATE CONTENT EXPECTATIONS – HIGH SCHOOL (GRADES 9-12)

### Topic Bundle 1: Space Systems

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards: <a href="#">HS-ESS1-1</a> and <a href="#">ESS1-3</a>.</b></p> <p><b>HS-ESS1-1.</b> Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.</p> <p><b>HS-ESS1-3.</b> Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p>			
<p><b>EE.HS-ESS1-1-3: Use a model to observe and describe that reactions inside the Sun release energy as radiation, and some of this radiation reaches Earth.</b></p>	<p><b>EE.HS-ESS1-H.1-3:</b> Use a model to describe that reactions inside the Sun release energy as radiation, and some of this radiation reaches Earth.</p>	<p><b>EE.HS-ESS1-M.1-3:</b> Use a model to trace the path of solar radiation (as heat and light) from the Sun to Earth.</p>	<p><b>EE.HS-ESS1-L.1-3:</b> Use a model of the solar system (Sun, Earth, Moon) to identify the Sun as the source of heat and/or light for Earth.</p>

## Topic Bundle 1: Space Systems

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standard: HS-ESS1-4.</b> Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</p>			
<p><b>EE.HS-ESS1-4:</b> Given models or illustrations of the Sun, Earth, and Earth’s moon, identify that the Sun holds Earth in orbit and Earth holds its moon in orbit due to differences in mass that cause gravitational forces.</p>	<p><b>EE.HS-ESS1-H.4:</b> Given models or illustrations of the Sun, Earth, and Earth’s moon, identify that the Sun holds Earth in orbit and Earth holds its moon in orbit due to differences in mass that cause gravitational forces.</p>	<p><b>EE.HS-ESS1-M.4:</b> Given scaled models or illustrations, identify that planets orbit the Sun because it has greater mass or exerts greater gravitational force.</p>	<p><b>EE.HS-ESS1-L.4:</b> Given scaled models of Earth and the moon, identify the moon as the object orbiting Earth.</p>

## Topic Bundle 2: History of Earth

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standard: HS-ESS1-5, HS-ESS2-1, and HS ESS2-2.</b></p> <p><b>HS-ESS1-5.</b> Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</p> <p><b>HS-ESS2-1.</b> Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</p> <p><b>HS-ESS2-2.</b> Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems.</p>			
<p><b>EE.HS-ESS1-5_2-1-2: Use models to identify evidence of past and current tectonic plate movement and explain the relative ages of rocks in Earth’s crust.</b></p>	<p><b>EE.HS-ESS1-5_2-1-H.2:</b> Use models to identify evidence of past and current tectonic plate movement and explain the relative ages of rocks in Earth’s crust.</p>	<p><b>EE.HS-ESS1-5_2-1-M.2:</b> Given a simulation or demonstration, identify the effects of tectonic plates colliding (volcano eruptions, earthquake, etc.)</p>	<p><b>EE.HS-ESS1-5_2-1-L.2:</b> Use models to identify past effects of tectonic plate collisions (i.e., a volcano, earthquakes).</p>

## Topic Bundle 2: History of Earth

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards:</b></p> <p><b>HS-ESS1-6.</b> Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth’s formation and early history.</p> <p><b>HS-ESS2-3.</b> Develop a model based on evidence of Earth’s interior to describe the cycling of matter by thermal convection.</p>			
<p><b>EE.HS-ESS1-6-2-3:</b> Use models of the layers of Earth to show that the Earth formed over a long period of time.</p>	<p><b>EE.HS-ESS1-H.6-2-3:</b> Use models of the layers of Earth to show that the Earth formed over a long period of time.</p>	<p><b>EE.HS-ESS1-M.6-2-3:</b> Use a model to identify Earth’s crust, mantle, outer core, and inner core.</p>	<p><b>EE.HS-ESS1-L.6-2-3:</b> Use a model to identify the layer of Earth on which people live.</p>

### Topic Bundle 3: Earth's Systems

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standard: HS-ESS2-5.</b> Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p>			
<p><b>EE.HS-ESS2-5: Participate in an investigation to identify the effects of water on earth materials (such as soil, sand, rocks, etc.).</b></p>	<p><b>EE.HS-ESS2-H.5:</b> Participate in an investigation to identify the effects of water on earth materials (such as soil, sand, rocks, etc.).</p>	<p><b>EE.HS-ESS2-M.5:</b> Use a model or simulation to identify erosion as the interaction of water and earth materials (such as soil or gravel).</p>	<p><b>EE.HS-ESS2-L.5:</b> In a demonstration of water's effect on soil or gravel, identify which material acted on the other (i.e., water washed away the soil).</p>

### Topic Bundle 3: Earth's Systems

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards: HS-ESS2-6 and HS-ESS2-7.</b></p> <p><b>HS-ESS2-6.</b> Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</p> <p><b>HS-ESS2-7.</b> Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</p>			
<p><b>EE.HS-ESS2-6-7: Use evidence to describe a simple carbon cycle between two or more Earth systems (hydrosphere, atmosphere, geosphere, and biosphere).</b></p>	<p><b>EE.HS-ESS2-H.6-7:</b> Use evidence to describe a simple carbon cycle between two or more Earth systems (hydrosphere, atmosphere, geosphere, and biosphere).</p>	<p><b>EE.HS-ESS2-M.6-7:</b> Use a model or illustration to describe the dependence on oxygen and/or carbon dioxide between people and plants.</p>	<p><b>EE.HS-ESS2-L.6-7:</b> Use a model or illustration of the interdependency between plants and people to identify that people breathe in oxygen.</p>

## Topic Bundle 4: Weather and Climate

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards: HS-ESS3-5 and HS-ESS2-4.</b></p> <p><b>HS-ESS3-5.</b> Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</p> <p><b>HS-ESS2-4.</b> Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.</p>			
<p><b>EE.HS-ESS3-5_2-4: Use weather data to describe changes in local, regional, and global climate.</b></p>	<p><b>EE.HS-ESS3-5_2-H.4:</b> Use weather data to describe changes in local, regional, and global climate.</p>	<p><b>EE.HS-ESS3-5_2-M.4:</b> Use descriptions and illustrations to identify weather patterns in a given region.</p>	<p><b>EE.HS-ESS3-5_2-L.4:</b> Given weather and non-weather data, identify the weather data.</p>

## Topic Bundle 5: Human Sustainability

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standard: HS-ESS3-1.</b> Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p>			
<p><b>EE.HS-ESS3-1: Use evidence to describe how natural resources, natural hazards, and climate change affect human populations.</b></p>	<p><b>EE.HS-ESS3-H.1:</b> Use evidence to describe how natural resources, natural hazards, and climate change affect human populations.</p>	<p><b>EE.HS-ESS3-M.1:</b> Given evidence about natural resources or natural hazards in an area, identify one or more positive and/or negative ways that humans may be affected.</p>	<p><b>EE.HS-ESS3-L.1:</b> Given a model, identify a natural resource and/or a natural hazard.</p>



## Topic Bundle 5: Human Sustainability

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards: HS-ESS3-2 and HS-ESS3-4.</b></p> <p><b>HS-ESS3-2.</b> Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p> <p><b>HS-ESS3-4.</b> Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p>			
<p><b>EE.HS-ESS3-2-4: Participate in investigations to determine and/or describe a solution that best results in reducing the human impact on a natural resource.</b></p>	<p><b>EE.HS-ESS3-H.2-4:</b> Participate in investigations to determine and/or describe a solution that best results in reducing the human impact on a natural resource.</p>	<p><b>EE.HS-ESS3-M.2-4:</b> Given a natural resource, identify a human activity that demonstrates conservation or a reduced human impact on that natural resource.</p>	<p><b>EE.HS-ESS3-L.2-4:</b> Match a human activity or behavior to a natural resource it is intended to conserve.</p>

## Topic Bundle 5: Human Sustainability

Target Alternate Content Expectation	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
<p><b>Michigan K-12 Science Content Standards: HS-ESS3-3 and HS-ESS3-6.</b></p> <p><b>HS-ESS3-3.</b> Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p> <p><b>HS-ESS3-6.</b> Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</p>			
<p><b>EE.HS-ESS3-3-6: While exploring and asking questions about biodiversity, use evidence to describe the effects of human populations on biodiversity and the sustainable use of natural resources (students are not expected to define biodiversity).</b></p>	<p><b>EE.HS-ESS3-H.3-6:</b> While exploring and asking questions about biodiversity, use evidence to describe the effects of human populations on biodiversity and the sustainable use of natural resources (students are not expected to define biodiversity).</p>	<p><b>EE.HS-ESS3-M.3-6:</b> Given evidence about a human population and a natural resource being used, identify whether the resource will increase, decrease, or remain the same (sustainable use).</p>	<p><b>EE.HS-ESS3-L.3-6:</b> Given a picture of a human development (population), identify a natural resource that is being used.</p>