

Earth and Space Science

Earth and Space Science is based on the Earth and space science domain, with content focused on our ever-changing planet and its weather, Earth's place in the universe, and the integration of its constantly evolving systems. Content also includes historical perspectives on the universe and Alabama's contributions to space exploration. Earth and Space Science is strongly recommended for all high school students.

The course is based on two disciplinary core ideas in the earth and space science domain. The first core idea, "Earth's Place in the Universe," addresses stars and star properties, the solar system and the universe, and historical astronomical perspectives. The second core idea, "Earth's Systems," examines the composition and history of the Earth, plate tectonics, weather, climate, and severe weather.

Embedded in the content standards are the disciplinary core ideas of the Engineering, Technology, and Applications of Science (ETS) domain, which require students to use design strategies in conjunction with knowledge and understanding of science and technology to solve practical problems.

Teachers are encouraged to incorporate current, relevant information from scientific literature and draw upon local resources to engage students and extend the disciplinary core ideas. Standards are written so students can access and expand upon prior knowledge, incorporate personal experiences, and integrate new learning to build conceptual understanding. The content standards foster scientific, mathematical, and graphical literacy to prepare students for post-secondary study, careers, and citizenship.

Although not included as discrete standards, these practices should be embedded throughout each unit:

- Measurement - Choose appropriate tools and record measurements with the correct units.
- Mathematics - Calculate ratios, rates, percentages, and unit conversions to represent and solve scientific and engineering problems.
- Graphic literacy- Read, analyze, and interpret graphs, charts, and tables to address a scientific question or solve a problem.

Each content standard completes the stem “*Students will...*”

Earth’s Place in the Universe		
Stars and Star Properties	1. Obtain, evaluate, and communicate information about the connections among mass, gravity, and fusion in the life cycle of stars.	Patterns
	a. Utilize models to explain the process of stellar evolution from star birth to star death.	Stability and Change
	b. Interpret the Hertzsprung-Russell diagram to analyze the properties of stars, including density, magnitude, temperature, rates of fusion, and spectral class.	Systems and System Models
	c. Obtain, evaluate, and communicate information about how nuclear fusion in stars and supernovas leads to the formation of all other elements.	Cause and Effect
	d. Analyze and interpret data to quantify the energy produced in stars, using Einstein’s theory of general relativity by applying $E=mc^2$ to show that the small amount of mass produced during hydrogen fusion produces a large amount of energy.	Energy and Matter
The Solar System and the Universe	2. Obtain, evaluate, and communicate information about the structure and motion of components of the universe and solar system. a. Use mathematics and computational thinking to predict the motion of natural and man-made objects in the solar system, using Kepler’s laws, Newton’s laws of motion, and Newton’s gravitational laws. b. Use mathematics and computational thinking to explain the relationships between the properties of light and distances in the solar system and universe, including the Doppler effect, red shift, light years, and astronomical units.	Cause and Effect

	<p>c. Analyze spectroscopic data to determine the properties and motion of objects in space. <i>Example: Use spectral lines to identify unknown elements in stars. Use a blackbody curve to determine the temperature of objects in space.</i></p>	Patterns
	<p>d. Investigate and communicate major properties of bodies in the solar system and the zones they inhabit. <i>Examples: planets, dwarf planets, major moons, asteroid belt, comets, the Kuiper belt, the Öort cloud</i></p>	Structure and Function
	<p>e. Use mathematics to explain how solar intensity and the tilt of the Earth's axis impact the distribution of sunlight on the Earth's surface, including zenith angle, solar angle, and surface area.</p>	Patterns
Historical Perspectives	<p>3. Research, evaluate, and communicate information about how the findings of early astronomers, including Aristotle, Ptolemy, Copernicus, Galileo, Brahe, Kepler, Newton, and Einstein, challenged the thinking of their time, allowed for academic advancements, and built a foundation for space exploration. <i>Examples: Ptolemy supported a geocentric solar system with fixed stars, circular orbits of planets, and a perfect and unchanging universe. Kepler supported a heliocentric solar system, elliptical orbits of planets, and a changing universe; his laws predict the motions of satellites.</i></p> <p>a. Obtain and evaluate scientific information that explains how the application of new knowledge and technological advances has improved human understanding of the universe. <i>Examples: Annie Cannon designed a star classification system based on star color and temperature that is still used today. Edwin Hubble used Christian Doppler's research to determine redshift. Robert Wilson and Arno Penzias discovered Cosmic Background Radiation, providing evidence for an expanding universe. Stephen Hawking and Neil deGrasse Tyson made astronomy more accessible to the public.</i></p>	Cause and Effect

	b. Construct an evidence-based explanation of the connections among various cosmic phenomena, citing leading scientific theories.	Energy and Matter
	c. Obtain and communicate information about Alabama's contributions to space exploration.	Cause and Effect
Earth's Systems		
Composition of the Earth	<p>4. Obtain, evaluate, and communicate information about the geologic conditions and processes that form different Earth materials.</p> <p>a. Plan and carry out investigations to explore the processes that form plutonic (intrusive) and volcanic (extrusive) igneous rocks of differing compositions and textures. <i>Example: Conduct a crystallization experiment to determine how speed of cooling affects crystal size.</i></p>	Energy and Matter
	<p>b. Analyze and interpret data to explain the effects of mechanical and chemical weathering and erosion on Earth's materials by wind, water, ice, and gravity.</p> <p>c. Construct an explanation using evidence from experiments, models, or data of the processes that create and transform igneous, sedimentary, and metamorphic rocks.</p> <p>d. Plan and conduct an investigation on water's effect on surface and subsurface processes. <i>Examples: Use particles of varying sizes to determine how the speed of water impacts particle distribution. Use the porosity and permeability of particles of various sizes to determine how the size and sorting of particles affects water movement.</i></p> <p>e. Obtain and communicate information about significant geologic characteristics in Alabama and the southeastern United States. <i>Examples: types of rocks, caves, sinkholes, minerals, energy resources</i></p>	Cause and Effect

Earth's History	<p>5. Obtain, evaluate, and communicate information about major events in Earth's history.</p> <p>a. Analyze and interpret data to sequence events in Earth's history, including relative and absolute dating techniques, principles of superposition and crosscutting relationships, igneous intrusions, radiometric dating, and the fossil record.</p>	Patterns
	<p>b. Construct an explanation based on evidence of how catastrophic and long-term events have impacted life on Earth, including mass extinctions.</p> <p>c. Construct explanations from evidence of how the flow of energy through Earth's systems has changed over time. <i>Example: Earth's oxygen level was lowest during the Cryptozoic Eon (Precambrian) and highest in the Carboniferous.</i></p> <p>d. Obtain, evaluate, and communicate information about important tectonic and geologic events that have occurred in Alabama over geologic time. <i>Examples: geologic ages and types of rocks, fluctuations in sea levels, temperature changes</i></p>	Cause and Effect
Plate Tectonics	<p>6. Obtain, evaluate, and communicate information about the theory of plate tectonics.</p>	Patterns
	<p>a. Construct an evidence-based explanation of continental drift, basing conclusions on comparisons of coastlines, fossils, ages of rocks, climate, and magnetic patterns.</p> <p>b. Construct an explanation, based on evidence, of tectonic plate movement, types of plate boundaries, and how boundary type relates to specific tectonic features, including mountain ranges, earthquakes, volcanism, volcanic islands, hotspots, mid-ocean ridges, and faults.</p>	Stability and Change
	<p>c. Develop and interpret a model of Earth's internal structure and composition, including inner core, outer core, asthenosphere, lithosphere, mantle, and crust.</p>	Systems and System Models

	d. Analyze data to interpret seismic activity and assess the risk of volcanic eruptions and earthquakes in Alabama and other areas in the United States.	
Weather	7. Obtain, evaluate, and communicate information about the role of energy transfer in wind, precipitation, cloud formation, and front formation. a. Obtain and communicate information to explain how water cycles through the atmosphere, including condensation, evaporation, clouds, types of precipitation, relative humidity, and dew point.	Cause and Effect
	b. Plan and carry out an investigation to determine the differential heating of land and water and explain how these differences create changes in local and global weather. <i>Example: Heat water and soil under lamps for 10 minutes and allow water and soil to cool for 10 minutes, then apply the results to explain land and sea breezes.</i> c. Construct an explanation of how air masses, source regions, fronts, weather changes associated with frontal passage (including cold, warm, occluded, and stationary fronts), air pressure, air density, temperature, cloud types, and precipitation are related to each other. d. Use data to construct an explanation of the role of pressure differences in the development of wind systems. <i>Examples: Analyze high and low pressure centers to determine direction of air motion. Calculate pressure gradients to determine the direction of air motion.</i>	Systems and System Models
	e. Analyze and interpret data to create a surface map, including high-pressure and low-pressure systems, isobars, wind barbs, cloud types, precipitation, and fronts.	Stability and Change

Climate and Severe Weather	<p>8. Obtain and communicate information to explain different climate regions and their impact on patterns of severe weather.</p> <ul style="list-style-type: none">a. Analyze temperature and precipitation patterns related to factors that influence climate, including proximity to water, topography, elevation, latitude, and orographic effect.b. Analyze and interpret data to develop predictions about the formation of meteorological events. <i>Examples: severe thunderstorms, hurricanes, tornadoes, floods, droughts, winter storms</i>c. Communicate scientific information to explain the personal, local, and statewide implications of severe weather events in Alabama.	Cause and Effect
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