Alabama Science

# Earth and Space Science

**Earth's Place in the Universe**

**Stars and Star Properties**

**Patterns**

1 Obtain, evaluate, and communicate information about the connections among mass, gravity, and fusion in the life cycle of stars. ESS.1

**Stars and Star Properties**

**Stability and Change**

**Stars and Star Properties**

**Systems and System Models**

**Stars and Star Properties**

**Cause and Effect**

**Stars and Star Properties**

**Energy and Matter**

**The Solar System and the Universe**

**Cause and Effect**

2 Obtain, evaluate, and communicate information about the structure and motion of components of the universe and solar system. ESS.2

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. ESS.2.A

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. ESS.2.B

**The Solar System and the Universe**

**Patterns**

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**he Solar System and the Universe**

**Structure and Function**

**The Solar System and the Universe**

**Patterns**

**Historical Perspectives**

**Cause and Effect**

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. ESS.3

a Obtain and evaluate scientific information that explains how the application of new knowledge and technological advances has improved human understanding of the universe. ESS.3.A

**Historical Perspectives**

**Energy and Matter**

**Historical Perspectives**

**Cause and Effect**

**Utilize models to explain the process of stellar evolution from star birth to star death.** ESS.1.A

a **Utilize models to explain the process of stellar evolution from star birth to star death.** ESS.1.A

**Interpret the Hertzsprung-Russell diagram to analyze the properties of stars, including density, magnitude, temperature, rates of fusion, and spectral class.** ESS.1.B

b **Interpret the Hertzsprung-Russell diagram to analyze the properties of stars, including density, magnitude, temperature, rates of fusion, and spectral class.** ESS.1.B

**Obtain, evaluate, and communicate information about how nuclear fusion in stars and supernovas leads to the formation of all other**

c **Obtain, evaluate, and communicate information about how nuclear fusion in stars and supernovas leads to the formation of all other elements.** ESS.1.C

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| **Analyze and interpret data to quantify the energy produced in stars, using Einstein's theory of general relativity by applying E=mc2 to show that the small amount of mass produced during hydrogen fusion produces a large amount of energy.** ESS.1.D | **d** **Analyze and interpret data to quantify the energy produced in stars, using Einstein's theory of general relativity by applying E=mc2 to show that the small amount of mass produced during hydrogen fusion produces a large amount of energy.** ESS.1.D |
| **Analyze spectroscopic data to determine the properties and motion of objects in space.** ESS.2.C | **c** **Analyze spectroscopic data to determine the properties and motion of objects in space.** ESS.2.C |
| **Investigate and communicate major properties of bodies in the solar system and the zones they inhabit.** ESS.2.D | **d** **Investigate and communicate major properties of bodies in the solar system and the zones they inhabit.** ESS.2.D |
| **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.** ESS.2.E | **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.** ESS.2.E |
| **Construct an evidence-based explanation of the connections among various cosmic phenomena, citing leading scientific theories.** ESS.3.B | **b** **Construct an evidence-based explanation of the connections among various cosmic phenomena, citing leading scientific theories.** ESS.3.B |
| **Obtain and communicate inf Ala** | **c** **Obtain and communicate information about Alabama's contributions to space exploration.** ESS.3.C |

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**to space exploration.** ESS.3.C

**Earth's Systems**

**Composition of the Earth**

**Energy and Matter**

4 Obtain, evaluate, and communicate information about the geologic conditions and processes that form different Earth materials. ESS.4

a Plan and carry out investigations to explore the processes that form plutonic (intrusive) and volcanic (extrusive) igneous rocks of differing compositions and textures. ESS.4.A

**Composition of the Earth**

**Cause and Effect**

**Earth's History**

**Patterns**

5 Obtain, evaluate, and communicate information about major events in Earth's history. ESS.5

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. ESS.5.A

**Earth's History**

**Cause and Effect**

**Plate Tectonics**

**Patterns**

6 Obtain, evaluate, and communicate information about the theory of plate tectonics. ESS.6

**Plate Tectonics**

**Stability and Change**

**Plate Tectonics**

**Systems and System Models**

**Weather**

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**ause and Effect**

7 Obtain, evaluate, and communicate information about the role of energy transfer in wind, precipitation, cloud formation, and front formation. ESS.7

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. ESS.7.A

**Weather**

**Systems and System Models**

**Weather**

**Stability and Change**

**Climate and Severe Weather**

**Cause and Effect**

8 Obtain and communicate information to explain different climate regions and their impact on patterns of severe weather. ESS.8

a Analyze temperature and precipitation patterns related to factors that influence climate, including proximity to water, topography, elevation, latitude, and orographic effect. ESS.8.A

b Analyze and interpret data to develop predictions about the formation of meteorological events. ESS.8.B

c Communicate scientific information to explain the personal, local, and statewide implications of severe weather events in Alabama. ESS.8.C

**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.** ESS.4.B

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.** ESS.4.B

**Construct an explanation using evidence from experiments, models, or data of the processes that create and transform igneous, sedimentary, and metamorphic ro**

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c **Construct an explanation using evidence from experiments, models, or data of the processes that create and transform igneous, sedimentary, and metamorphic rocks.** ESS.4.C

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| **Plan and conduct an investigation on water's effect on surface and subsurface processes.** ESS.4.D | **d** **Plan and conduct an investigation on water's effect on surface and subsurface processes.** ESS.4.D |
| **Obtain and communicate information about significant geologic characteristics in Alabama and the southeastern United States.** ESS.4.E | **e** **Obtain and communicate information about significant geologic characteristics in Alabama and the southeastern United States.** ESS.4.E |
| **Construct an explanation based on evidence of how catastrophic and long-term events have impacted life on Earth, including mass extinctions.** ESS.5.B | **b** **Construct an explanation based on evidence of how catastrophic and long-term events have impacted life on Earth, including mass extinctions.** ESS.5.B |
| **Construct explanations from evidence of how the flow of energy through Earth's systems has changed over time.** ESS.5.C | **c** **Construct explanations from evidence of how the flow of energy through Earth's systems has changed over time.** ESS.5.C |
| **Obtain, evaluate, and communicate information about important tectonic and geologic events that have occurred in Alabama over geologic time.** ESS.5.D | **d** **Obtain, evaluate, and communicate information about important tectonic and geologic events that have occurred in Alabama over geologic time.** ESS.5.D |
| **Construct an evidence-based explanation of continental drift, basing conclusions on comparisons of coastlines, fossils, ages of ma pa** | **a** **Construct an evidence-based explanation of continental drift, basing conclusions on comparisons of coastlines, fossils, ages of rocks, climate, and magnetic patterns.** ESS.6.A |

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| 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. ESS.6.B | **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. ESS.6.B |
| Develop and interpret a model of Earth's internal structure and composition, including inner core, outer core, asthenosphere, lithosphere, mantle, and crust. ESS.6.C | **c** Develop and interpret a model of Earth's internal structure and composition, including inner core, outer core, asthenosphere, lithosphere, mantle, and crust. ESS.6.C |
| Analyze data to interpret seismic activity and assess the risk of volcanic eruptions and earthquakes in Alabama and other areas in the United States. ESS.6.D | **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. ESS.6.D |
| 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. ESS.7.B | **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. ESS.7.B |
| Construct an explanation of how air masses, source regions, fronts, weather changes ass pa warm, occluded, and | **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. ESS.7.C |

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| **stationary fronts), air pressure, air density, temperature, cloud types, and precipitation are related to each other.** ESS.7.C | |
| **Use data to construct an explanation of the role of pressure differences in the development of wind systems.** ESS.7.D | **d** **Use data to construct an explanation of the role of pressure differences in the development of wind systems.** ESS.7.D |
| **Analyze and interpret data to create a surface map, including high-pressure and low-pressure systems, isobars, wind barbs, cloud types, precipitation, and fronts.** ESS.7.E | **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.** ESS.7.E |