Huntsville City Schools

Pacing Guide 2016 - 2017

Earth and Space Science Grade: 11-12

The Earth and Space Science course is highly recommended for all high school students. Content focuses on a comprehensive application of all disciplines of science and is based upon the biologically active nature of our ever-changing planet and integration of systems that constantly evolve. In an effort to encourage students to pursue career in the fields of science, technology, engineering, and mathematics (STEM), this course incorporates the scientific and engineering practices that reflect the scientific processes used by scientists. The scientific and engineering practices are implements through a student-centered, laboratory-intensive, collaborative classroom environment.

The Earth and Space Science standards provide a depth of conceptual understanding to adequately prepare students for college, career, and citizenship with an appropriate level of scientific literacy. Resources specific to the local area as well as external resources, including evidence-based literature found within scientific journals, should be used to extend and increase the complexity of the core ideas.

The foundation of the course is taken from two disciplinary core ideas in the Earth and Space Science domain. The first core idea, Earth's Place in the Universe, addresses the concepts of the *universe and its stars, Earth and the solar system, and the history of the planet Earth. The second core idea, Earth's Systems, examines Earth's materials and systems, plate tectonics and large-scale system interactions, the roles of water in Earth's surface processes, weather and climate, and biogeology. Integrated within the disciplinary core ideas of Earth and Space Science are the Engineering, Technology, and Applications of Science (ETS) core ideas, which are denoted with an asterisk (*). The ETS core ideas require students to use tools and materials to solve simple problems and to use representations to convey design solutions to a problem and determine which is most appropriate.

Reading Standards for Grades 11-12 Students

1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to Grades 11-12 texts and topics.
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g. quantitative data, video, multimedia) in order to address a question or solve a problem.
8. Evaluate the hypotheses, data, analysis and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Writing Standards for Grades 11-12 Students

1. Write arguments focused on discipline-specific content (additional detail in the Course of Study)
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes (additional detail in the Course of Study).
3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
6. Conduct short as well as more sustained research projects to answer a question (including a self-generated questions_ or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively, assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
8. Draw evidence from informational texts to support analysis, reflection, and research.
9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

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First Nine Weeks

By the end of the **first nine weeks,** students should be able to understand, but is not limited to, the following topics:

- Early Astronomers
- Kepler's and Newton's Laws
- Birth of the Universe
- Origin of the Solar System
- Seasons
- Lunar Phases
- Planets

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

Second Nine Weeks

By the end of the **second nine weeks,** students should be able to understand, but is not limited to, the following topics:

- Studying the Sun
- Studying Light
- Visualizing Patterns Among Stars
- Stellar Lives
- White Dwarfs, Neutron Stars, and Black Holes

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

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First Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 6 Obtain and evaluate information about Copernicus, Galileo, Kepler, Newton, and Einstein to communicate how their findings challenged conventional thinking and allowed for academic advancements and space exploration.	**Pearson The Cosmic Perspective Textbook** • **A Modern View of the Universe: Chapter 1** • **Changes in Our Perspective: Chapter 3** **Pearson Earth Science Textbook** • **Origin of Modern Astronomy: Chapter 22** **Additional Suggestions** • **The Cosmic Perspective Study Area** o Orbits and Kepler's Third Law o Elliptical Orbits o Angular Momentum o Cosmic Distance Measurements o Estimating the Age of a Universe with Dark Energy o Narrated Figures	**10 hours**
ALCOS 2 Engage in argument from evidence to compare various theories for the formation and our solar system (e.g. Big Bang Theory, Hubble's law, steady state theory, light spectra, motion of distant galaxies, composition of matter in the universe).	**Pearson The Cosmic Perspective Textbook** • **The Birth of the Universe: Chapter 13** • **Origin of the Solar System: Chapter 4** • **Terrestrial Worlds: Chapter 5** • **The Outer Solar System: Chapter 6** • **Galaxies: Chapter 12** • **Galaxy Distances and Hubble's Law: Chapter 12** **Pearson Earth Science Textbook**	**20 hours**

	• **Touring Our Solar System: Chapter 23** • **Studying the Sun: Chapter 24** **Additional Suggestions** • **<u>Teacher Demo:</u>** Speeding Up a Spinning Nebula (pg. 647) • **<u>The Cosmic Perspective Study Area</u>** o Evidence for the Big Bang	

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Second Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 1 Develop and use models to illustrate the lifespan of the sun, including energy released during nuclear fusion that eventually reaches Earth through radiation. **ALCOS 5** Use mathematics to explain the relationship of the seasons to the tilt of the Earth's axis (e.g., zenith angle, solar angle, surface area) and its revolution about the sun, addressing intensity and distribution of sunlight on Earth's surface.	**Pearson The Cosmic Perspective Textbook** • **Understanding the Sky: Chapter 2** • **The Sun and Other Stars: Chapter 8** • **Studying the Sun: Chapter 24** **Additional Suggestions** • **Inquiry Activity**: What is the Shape of a Planetary Orbit? (pp. 642-643) • **Inquiry Activity:** How Does the Position of the Setting Sun Change? (pp. 672-673) • **Teacher Demo:** Making a Simple Spectrometer (pg. 676) • **Using Models:** The Active Sun (pg. 687)	**12 hours**
ALCOS 3 Evaluate and communicate scientific information (e.g., Hertzsprung-Russell diagram) in reference to the life cycle of stars using data of both atomic emission and absorption spectra of stars to make inferences about the presence of certain elements.	**Pearson The Cosmic Perspective Textbook** • **Stellar Lives: Chapter 9** • **The Bizarre Stellar Graveyard: Chapter 10** **Pearson Earth Science Textbook** • **Beyond Our Solar System: Chapter 25** **Additional Suggestions** • **Teacher Demo:** Apparent and Absolute Magnitude (pg. 703) • **Using Models:** Types of Galaxies (pg. 717)	**12 hours**
ALCOS 4 Apply mathematics and computational thinking in reference to Kepler's laws, Newton's	**Pearson The Cosmic Perspective Textbook** • **Appendixes A-C**	**6 hours**

laws of motion, and Newton's gravitational laws to predict the orbital motion of natural and man-made objects in the solar system.	**Additional Suggestions** • **The Cosmic Perspective Study Area** o Orbits and Kepler's Third Law o Elliptical Orbits o Angular Momentum o Cosmic Distance Measurements o Estimating the Age of a Universe with Dark Energy o Narrated Figures	

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Course Earth and Space Science Grade 11-12

Third Nine Weeks

By the end of the **first nine weeks,** students should be able to understand, but is not limited to, the following topics:

- Earth's Layers
- Rock Cycle
- Weathering
- Mechanisms of Tectonic Plate Movement
    - Volcanoes
    - Earthquakes
    - Mountains
- Mineral Resources in Energy

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

Fourth Nine Weeks

By the end of the **second nine weeks,** students should be able to understand, but is not limited to, the following topics:

- Geologic Time and Earth's History
- Dynamic Ocean
- Ocean Floor Features
- Running Water
- Precipitation
- Weather Patterns

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

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Earth and Space Science Grade: 11-12

Third Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
Earth's Layers, Rock Cycle, Energy **ALCOS 10** Construct an explanation from evidence for the processes that generate the transformation of rocks in Earth's crust, including chemical composition of minerals and characteristics of sedimentary, igneous, and metamorphic rocks. **ALCOS 11** Obtain and communicate information about significant geologic characteristics (e.g., types of rocks and geologic ages, earthquake zones, sinkholes, caves, abundant fossil fauna, mineral and energy resources) that impact life in Alabama and the southeastern United States.	**Pearson Earth Science Textbook** • **Earth's Layers: Chapter 8.4** • **Rock Cycle: Chapter 3** • **Mineral and Energy Resources: Chapter 4** **Additional Suggestions** • **Dynamic Earth Interactive** https://www.learner.org/interactives/dynamicearth/ • **Rock Cycle Interactive** https://www.learner.org/interactives/rockcycle/index.html • **Inquiry Activity:** What Are Some Similarities and Differences Among Rocks? (pg. 65) • **Diagram:** Students construct a diagram of the rock cycle • **Teacher Demo:** Weathering (pg. 68) • **Teacher Demo:** Classification of Igneous Rocks (pg. 72) • **Teacher Demo:** Chemical Weathering (pg. 77) • **Designing Experiments:** Students design an experiment to show how sedimentary rocks form when dissolved mineral precipitate from water. • **Investigation:** Give students samples of sandstone, siltstone, shale, breccia, and conglomerate. Have them use magnifying glasses to classify rocks according to grain size. • **Quick Lab:** Observing Some of the Effects of Pressure on Mineral Grains (pg. 82) • **Exploration Lab:** Rock Identification (pp. 86-87) • **Inquiry Activity:** How Can You Determine the Resources You Use? (pg. 93)	**15 hours**

Weathering, Plate Tectonics, Volcanoes, and Mountains **ALCOS 9** Obtain, evaluate, and communicate information to explain how constructive and destructive processes (e.g., weathering, erosion, volcanism, orogeny, plate tectonics, tectonic uplift) shape and Earth's land features (e.g. mountains valleys, plateaus) and sea features (e.g. trenches, ridges, seamounts). **ALCOS 13** Analyze and interpret data of interactions between the hydrologic and rock cycles to explain the mechanical impacts (e.g. stream transportation and deposition, erosion, frost-wedging) and chemical impacts (e.g. oxidation hydrolysis, carbonation) of Earth materials by water's properties.	**Pearson Earth Science Textbook** • **Weathering: Chapter 5.1** • **Plate Tectonics: Chapter 9** • **Volcanoes: Chapter 10** • **Mountains: Chapter 11** **Carolina Biological Supply** • Carolina Modeling Tectonic Plate Boundaries Kit (Highly Recommended) • Geology Demonstration Kit (Highly Recommended) • Landform Model Set • GeoBlox Set **Additional Suggestions** • **Volcanoes Interactive** https://www.learner.org/interactives/volcanoes/ • **Dynamic Earth Interactive** https://www.learner.org/interactives/dynamicearth/ • **Plate Tectonics (PhET Simulation)** https://phet.colorado.edu/en/simulation/legacy/plate-tectonics • **Inquiry Activity:** What Causes Weathering? (pg. 125) • **Designing Experiments:** Students work in small groups to design experiments showing how water expands when frozen. (pg. 127) • **Teacher Demo:** Modeling Exfoliation (pg. 128) • **Inquiry Activity:** How Do the Continents Fit Together? (pg. 247) • **Teacher Demo:** Matching Fossils (pg. 249) • **Quick Lab:** Charting the Age of the Atlantic Ocean (pg. 251) • **Teacher Demo:** Testing Minerals for Magnetism (pg. 258) • **Inquiry Activity:** Where are Volcanoes Located? (pg. 279) • **Quick Lab:** Why are some volcanoes explosive? (pg. 287) • **Teacher Demo:** Observing Viscosity (pg. 288) • **Lab:** Students should explore viscosity and role of gases in the explosive nature of a volcano.	**15 hours**

	• **Inquiry Activity:** Can You Model How Rocks Deform? (pg. 307) • **Teacher Demo:** Making an Anticline (pg. 313) • **Using Models:** Have students build a model of each of the mountain faults, folds, and landforms. • **Teacher Demo:** Partial Melting (pg. 321) • **Exploration Lab:** Investigating Anticlines and Synclines (pp. 326-327) • **Concept Map:** Students make a concept map using the term ocean floor features at the starting point. • **Teacher Demo:** Sediment Buildup (pg. 404)	
Earthquakes **ALCOS 12** Develop a model of Earth's layers using available evidence to explain the role of thermal convection in the movement of Earth's materials (e.g. seismic waves, movement of tectonic plates).	**Pearson Earth Science Textbook** • **Earthquakes: Chapter 8** **Additional Suggestions** • **Inquiry Activity:** How Can Building Be Made Earthquake Safe? (pg. 217) • **Teacher Demo:** Sweet Stress (pg. 219) • **Teacher Demo:** Seismic Waves (pg. 223) • **Reading Maps:** Have students analyze the locations of earthquakes on a map. Relate to tectonic plate activity. • **Exploration Lab:** Locating an Earthquake (pp. 240-241)	**3 hours**

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Fourth Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
Earth's History, Geologic Time **ALCOS 8** Develop a time scale model of Earth's biological and geological history to establish relative and absolute age of major events in Earth's history (e.g. radiometric dating, models of geologic cross sections, sedimentary layering, fossilization, early life forms, fossilization, early life forms, folding, faulting, igneous intrusions).	**Pearson Earth Science Textbook** • **Geologic Time: Chapter 12** • **Earth's History: Chapter 13** **Additional Suggestions** • **Geologic Time Scale Game** http://www.purposegames.com/game/318 • **Radioactive Dating Game (PhET Simulation)** https://phet.colorado.edu/en/simulation/legacy/radioactive-dating-game • **Inquiry Activity:** What Can Become a Fossil? (pg. 335) • **Using Models:** Have students construct three-dimensional models of each of the unconformities. • **Using Models:** Have students work in small groups to make model mold and cast fossils. • **Teacher Demo:** Modeling Half-Lives (pg. 349) • **Exploration Lab:** Fossil Occurrence and the Age of Rocks (pp. 356-357) • **Inquiry Activity:** What are Fossils? (pg. 363) • **Graphic Organizer:** Have students create a flow chart to map the developments of species through geologic time • **Research:** Have students work in pairs to research a different period of geologic time and present to the class. Provide a rubric.	**9 hours**

	• **Application Lab:** Modeling the Geologic Time Scale (pp. 386-387)	
Dynamic Ocean and Ocean Floor **ALCOS 14** Construct explanations from evidence to describe how changes in the flow of energy through Earth's systems (e.g., volcanic eruptions, solar output, ocean circulation, surface temperatures, precipitation patterns, glacial ice volumes, sea levels Coriolis effect) impact the climate. **ALCOS 9** Obtain, evaluate, and communicate information to explain how constructive and destructive processes (e.g., weathering, erosion, volcanism, orogeny, plate tectonics, tectonic uplift) shape and Earth's land features (e.g. mountains valleys, plateaus) and sea features (e.g. trenches, ridges, seamounts).	**Pearson Earth Science Textbook** • **Dynamic Ocean: 16** • **Ocean Floor: Chapter 14** **Additional Suggestions** • **Inquiry Activity:** How Do Ocean Waves Form? (pg. 447) • **Teacher Demo:** Creating Density Currents (pg. 451) • **Using Models:** Students create a simple wave diagram showing the general shape of a wave then label each feature. • **Maps:** Identify shoreline features on a map of Alabama. • **Using Models:** Have students create three-dimensional models of the erosional and depositional shoreline features • **Exploration Lab:** Graphing Tidal Cycles (pp. 468-469) • **Teacher Demo:** Testing Minerals for Magnetism (pg. 258) • **Use Models:** Challenge students to use their hands, books, or other objects to model slab-pull and ridge-push. • **Exploration Lab:** Paleomagnetism and the Ocean Floor (pp. 272-273)	**6 hours**
Running Water and Groundwater **ALCOS 11** Obtain and communicate information about significant geologic characteristics (e.g., types of rocks and geologic ages, earthquake zones, sinkholes, caves, abundant fossil fauna, mineral and energy resources) that impact life in Alabama and the southeastern United States. **ALCOS 13** Analyze and interpret data of interactions between the hydrologic and rock cycles to explain the mechanical impacts (e.g. stream transportation and deposition, erosion, frost-wedging) and chemical impacts (e.g. oxidation hydrolysis, carbonation) of Earth materials by water's properties.	**Pearson Earth Science Textbook** • **Running Water: 6** • **Additional Suggestions** o **Stream table demonstration** o **Inquiry Activity:** How Do Local Bodies of Water Affect Your Community? (pg. 157) o **Diagram:** Students create a diagram of the water cycle. o **Using Models:** Have students create their own three-dimensional model of the water cycle. o **Teacher Demo:** Deposition (pg. 166) o **Designing Experiments:** Divide students into groups and ask them to model a delta using a sloped paint tray, sand, and water. (pg. 167) o **Concept Map:** Create a chart summarizing the differences between erosion, weathering, and deposition. o **Water Cycle** **http://www.montereyinstitute.org/noaa/lesson07/l7ex.swf**	**4.5 hours**

Precipitation **ALCOS 14** Construct explanations from evidence to describe how changes in the flow of energy through Earth's systems (e.g., volcanic eruptions, solar output, ocean circulation, surface temperatures, precipitation patterns, glacial ice volumes, sea levels Coriolis effect) impact the climate.	**Pearson Earth Science Textbook** o **Precipitation: 18** **Additional Suggestions** o **Inquiry Activity:** What Causes Condensation (pg. 503) o **Teacher Demo:** Air Compression and Expansion (pg. 511) o **Designing Experiments:** Students design experiments to determine the effects of temperature on the buoyancy of a helium balloon (pg. 514). o **Teacher Demo:** Making a Cloud (pg. 515) o **Exploration Lab:** Measuring Humidity (pp. 524-525)	**4.5 hours**
Weather Patterns **ALCOS 15** Obtain, evaluate, and communicate information to verify that weather (e.g., temperature, relative humidity, air pressure, dew point, adiabatic cooling, condensation, precipitation, winds, ocean currents, barometric pressure, wind velocity) is influenced by energy transfer within and among the atmosphere, lithosphere, biosphere, and hydrosphere. a. Analyze patterns in weather data to predict various systems, including fronts and severe storms. b. Use maps and other visualizations to analyze large data sets that illustrate the frequency, magnitude, and resulting damage from severe weather events in order to predict the likelihood and severity of future events.	**Pearson Earth Science Textbook** • **Weather Patterns** o **Chapter 19** o **Chapter 20** **Additional Suggestions** • **Weather Interactive** https://www.learner.org/interactives/weather/index.html • **Inquiry Activity:** How Do Gradients Influence Speed? (pg. 531) • **Teacher Demo:** Measuring the Mass of Air (pg. 532) • **Teacher Demo:** Air Pressure (pg. 533) • **Teacher Demo:** Differential Heating (pg. 544) • **Exploration Lab:** Observing Wind Patterns (pp. 550-551) • **Inquiry Activity:** How Can You Model the Movement of Air in a Tornado? (pg. 557) • **Research:** Have students research the air masses that are commonly experienced in Alabama. • **Using Models:** Students model the air masses and fronts • **Venn Diagram:** Have students create a Venn diagram of hurricanes and tornadoes. • **Application Lab:** Middle-Latitude Cyclones (pp 580-581)	**6 hours**

Listed below are the technology standards for grades nine through twelve. You are to make every effort to incorporate the applicable standards into your daily classroom lessons. These standards should be noted in your lesson plans.

Alabama Technology Standards Ninth – Twelfth Grade

Operations and Concepts

Students will:

2. Diagnose hardware and software problems.
   Examples: viruses, error messages
   Applying strategies to correct malfunctioning hardware and software
   Performing routine hardware maintenance
   Describing the importance of antivirus and security software

3. Demonstrate advanced technology skills, including compressing, converting, importing, exporting, and backing up files.
   Transferring data among applications
   Demonstrating digital file transfer
   Examples: attaching, uploading, downloading

4. Utilize advanced features of word processing software, including outlining, tracking changes, hyperlinking, and mail merging.

5. Utilize advanced features of spreadsheet software, including creating charts and graphs, sorting and filtering data, creating formulas, and applying functions.

6. Utilize advanced features of multimedia software, including image, video, and audio editing.

Digital Citizenship

9. Practice ethical and legal use of technology systems and digital content.
   Explaining consequences of illegal and unethical use of technology systems and digital content
   Examples: cyberbullying, plagiarism
   Interpreting copyright laws and policies with regard to ownership and use of digital content
   Citing sources of digital content using a style manual
   Examples: Modern Language Association (MLA), American Psychological Association (APA)

Research and Information Fluency

11. Critique digital content for validity, accuracy, bias, currency, and relevance.

Communication and Collaboration

12. Use digital tools to publish curriculum-related content.
    Examples: Web page authoring software, coding software, wikis, blogs, podcasts

13. Demonstrate collaborative skills using curriculum-related content in digital environments.

Examples: completing assignments online; interacting with experts and peers in a structured, online learning environment

Critical Thinking, Problem Solving, and Decision Making

14. Use digital tools to defend solutions to authentic problems.
    Example: disaggregating data electronically

Creativity and Innovation

15. Create a product that integrates information from multiple software applications.
    Example: pasting spreadsheet-generated charts into a presentation