Earth and Space Science

Overview

The standards establish the scientific inquiry skills and core content for all courses in DoDEA schools. The Earth science course of study provides students with a basic knowledge of the natural world that will serve as the foundation for more advanced secondary and postsecondary courses and will also give them the science skills necessary for earth-science oriented technical careers. The Earth and Space Science course takes a holistic look at the dynamic interactions in Earth and Space systems. Investigations are centered on complex topics such as geochemical cycles, the climate system, and the origin and evolution of the Earth's systems, the Solar System, and the Universe. In-depth understanding of these concepts requires students to apply knowledge from other scientific disciplines, such as physics, chemistry, and biology.

All DoDEA science courses are laboratory courses (minimum of 30 percent hands-on investigation). Earth Science laboratories will need to be stocked with all of the materials and apparatuses necessary to complete investigations. Instructional activities are staged in appropriate settings. They include laboratories, classrooms, forms of technology, and field studies. Teaching strategies include in depth laboratory investigations, demonstrations, collaborative peer-to-peer discussions, and student hands-on experiences. All aspects of progress in science are measured using multiple methods such as authentic assessments, performance assessments, formative assessments, observational assessments, projects, research activities, reports, group and individual student work and conventional summative assessments

Scientific Inquiry

The skills of scientific inquiry, including knowledge and use of tools, are not taught as separate skills in science, but are embedded throughout because these process skills are fundamental to all science instruction and content. A table of the PK–12 of scientific inquiry standards and Indicators: is provided in appendix A.

Standard:	**ESa:**	**The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.**
Indicators:	**ESa.1:**	Apply established rules for significant digits, both in reading scientific instruments and in calculating derived quantities from measurement.
	ESa.2:	Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.
	ESa.3:	Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.
	ESa.4:	Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.
	ESa.5:	Organize and interpret the data from a controlled scientific investigation by using mathematics (including calculations in scientific notation, formulas, and dimensional analysis), graphs, tables, models, diagrams, and/or technology.
	ESa.6:	Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.
	ESa.7:	Evaluate conclusions based on qualitative and quantitative data (including the impact of parallax, instrument malfunction, or human error) on experimental results.
	ESa.8:	Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).
	ESa.9:	Communicate and defend a scientific argument or conclusion.
	ESa.10:	Use appropriate safety procedures when conducting investigations.

Astronomy

Standard:	**ESb:**	**Students will demonstrate an understanding of the structure and properties of the universe.**
Indicators:	**ESb.1:**	Summarize the properties of the solar system that support the theory of its formation along with the planets.
	ESb.2:	Identify properties and features of the Moon that make it unique among other moons in the solar system.
	ESb.3:	Summarize the evidence that supports the big bang theory and the expansion of the

universe (including the red shift of light from distant galaxies and the cosmic background radiation).

ESb.4: Explain the formation of elements that results from nuclear fusion occurring within stars or supernova explosions.

ESb.5: Classify stars by using the Hertzsprung-Russell diagram.

ESb.6: Compare the information obtained through the use of x-ray, radio, and visual (reflecting and refracting) telescopes.

ESb.7: Summarize the life cycles of stars.

ESb.8: Explain how gravity and motion affect the formation and shapes of galaxies (including the Milky Way).

ESb.9: Explain how technology and computer modeling have increased our understanding of the universe.

Solid Earth

Standard: **ESc:** **Students will demonstrate an understanding of the internal and external dynamics of solid Earth.**

Indicators: **ESc.1:** Summarize theories and evidence of the origin and formation of Earth's systems by using the concepts of gravitational force and heat production.

ESc.2: Explain the differentiation of the structure of Earth's layers into a core, mantle, and crust based on the production of internal heat from the decay of isotopes and the role of gravitational energy.

ESc.3: Summarize theory of plate tectonics (including the role of convection currents, the action at plate boundaries, and the scientific evidence for the theory).

ESc.4: Explain how forces due to plate tectonics cause crustal changes as evidenced in earthquake activity, volcanic eruptions, and mountain building.

ESc.5: Analyze surface features of Earth in order to identify geologic processes (including weathering, erosion, deposition, and glaciation) that are likely to have been responsible for their formation.

ESc.6: Explain how the dynamic nature of the rock cycle accounts for the interrelationships among igneous, sedimentary, and metamorphic rocks.

ESc.7: Classify minerals and rocks on the basis of their physical and chemical properties and the environment in which they were formed.

ESc.8: Summarize the formation of ores and fossil fuels and the impact on the environment that the use of these fuels has had.

Earth's Atmosphere

Standard: **ESd:** **The student will demonstrate an understanding of the dynamics of Earth's atmosphere.**

Indicators:	**ESd.1:**	Summarize the thermal structures, the gaseous composition, and the location of the layers of Earth's atmosphere.
	ESd.2:	Summarize the changes in Earth's atmosphere over geologic time (including the importance of photosynthesizing organisms to the atmosphere).
	ESd.3:	Summarize the cause and effects of convection within Earth's atmosphere.
	ESd.4:	Attribute global climate patterns to geographic influences (including latitude, topography, elevation, and proximity to water).
	ESd.5:	Explain the relationship between the rotation of Earth and the pattern of wind belts.
	ESd.6:	Summarize possible causes of and evidence for past and present global climate changes.
	ESd.7:	Summarize the evidence for the likely impact of human activities on the atmosphere (including ozone holes, greenhouse gases, acid rain, and photochemical smog).
	ESd.8:	Predict weather conditions and storms (including thunderstorms, hurricanes, and tornados) on the basis of the relationship among the movement of air masses, high and low pressure systems, and frontal boundaries.
		Earth's Hydrosphere
Standard:	**ESe:**	**The student will demonstrate an understanding of Earth's freshwater and ocean systems.**
Indicators:	**ESe.1:**	Summarize the location, movement, and energy transfers involved in the movement of water on Earth's surface (including lakes, surface-water drainage basins [watersheds], freshwater wetlands, and groundwater zones).
	ESe.2:	Illustrate the characteristics of the succession of river systems.
	ESe.3:	Explain how karst topography develops as a result of groundwater processes.
	ESe.4:	Compare the physical and chemical properties of seawater and freshwater.
	ESe.5:	Explain the results of the interaction of the shore with waves and currents.
	ESe.6:	Summarize the advantages and disadvantages of devices used to control and prevent coastal erosion and flooding.
	ESe.7:	Explain the effects of the transfer of solar energy and geothermal energy on the oceans of Earth (including the circulation of ocean currents and chemosynthesis).
	ESe.8:	Analyze environments to determine possible sources of water pollution (including industrial waste, agriculture, domestic waste, and transportation devices).
		The Paleobiosphere
Standard	**ESf:**	**Students will demonstrate an understanding of the dynamic relationship between Earth's conditions over geologic time and the diversity of its organisms**.

Indicators:	**ESf.1:**	Summarize the conditions of Earth that enable the planet to support life.
	ESf.2:	Recall the divisions of the geologic time scale and illustrate the changes (in complexity and/or diversity) of organisms that have existed across these time units.
	ESf.3:	Summarize how fossil evidence reflects the changes in environmental conditions on Earth over time.
	ESf.4:	Match dating methods (including index fossils, ordering of rock layers, and radiometric dating) with the most appropriate application for estimating geologic time.
	ESf.5:	Infer explanations concerning the age of the universe and the age of Earth on the basis of scientific evidence.