

Chapter 112. Texas Essential Knowledge and Skills for Science Subchapter C. High School

Statutory Authority: The provisions of this Subchapter C issued under the Texas Education Code, §§7.102(c)(4), 28.002, and 28.025, unless otherwise noted.

§112.31. Implementation of Texas Essential Knowledge and Skills for Science, High School, Beginning with School Year 2010-2011.

The provisions of §§112.32-112.39 of this subchapter shall be implemented by school districts beginning with the 2010-2011 school year.

Source: The provisions of this §112.31 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 24, 2010, 35 TexReg 7230.

§112.36. Earth and Space Science, Beginning with School Year 2010-2011 (One Credit).

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Required prerequisites: three units of science, one of which may be taken concurrently, and three units of mathematics, one of which may be taken concurrently. This course is recommended for students in Grade 12 but may be taken by students in Grade 11.

(b) Introduction.

(1) Earth and Space Science (ESS). ESS is a capstone course designed to build on students' prior scientific and academic knowledge and skills to develop understanding of Earth's system in space and time.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) ESS themes. An Earth systems approach to the themes of Earth in space and time, solid Earth, and fluid Earth defined the selection and development of the concepts described in this paragraph.

(A) Earth in space and time. Earth has a long, complex, and dynamic history. Advances in technologies continue to further our understanding of the origin, evolution, and properties of Earth and planetary systems within a chronological framework. The origin and distribution of resources that sustain life on Earth are the result of interactions among Earth's subsystems over billions of years.

(B) Solid Earth. The geosphere is a collection of complex, interacting, dynamic subsystems linking Earth's interior to its surface. The geosphere is composed of materials that move between subsystems at various rates driven by the uneven distribution of thermal energy. These dynamic processes are responsible for the origin and distribution of resources as well as geologic hazards that impact society.

(C) Fluid Earth. The fluid Earth consists of the hydrosphere, cryosphere, and atmosphere subsystems. These subsystems interact with the biosphere and geosphere resulting in complex biogeochemical and geochemical cycles. The global ocean is the thermal energy reservoir for surface processes and, through interactions with the atmosphere, influences climate. Understanding these interactions and cycles over time has implications for life on Earth.

(6) Earth and space science strands. ESS has three strands used throughout each of the three themes: systems, energy, and relevance.

(A) Systems. A system is a collection of interacting physical, chemical, and biological processes that involves the flow of matter and energy on different temporal and spatial scales. Earth's system is composed of interdependent and interacting subsystems of the geosphere, hydrosphere, atmosphere, cryosphere, and biosphere within a larger planetary and stellar system. Change and constancy occur in Earth's system and can be observed, measured as patterns and cycles, and described or presented in models used to predict how Earth's system changes over time.

(B) Energy. The uneven distribution of Earth's internal and external thermal energy is the driving force for complex, dynamic, and continuous interactions and cycles in Earth's subsystems. These interactions are responsible for the movement of matter within and between the subsystems resulting in, for example, plate motions and ocean-atmosphere circulation.

(C) Relevance. The interacting components of Earth's system change by both natural and human-influenced processes. Natural processes include hazards such as flooding, earthquakes, volcanoes, hurricanes, meteorite impacts, and climate change. Some human-influenced processes such as pollution and nonsustainable use of Earth's natural resources may damage Earth's system. Examples include climate change, soil erosion, air and water pollution, and biodiversity loss. The time scale of these changes and their impact on human society must be understood to make wise decisions concerning the use of the land, water, air, and natural resources. Proper stewardship of Earth will prevent unnecessary degradation and destruction of Earth's subsystems and diminish detrimental impacts to individuals and society.

(c) Knowledge and skills.

(1) Scientific processes. The student conducts laboratory and field investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations;

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials; and

(C) use the school's technology and information systems in a wise and ethical manner.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable

explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) demonstrate the use of course equipment, techniques, and procedures, including computers and web-based computer applications;

(F) use a wide variety of additional course apparatuses, equipment, techniques, and procedures as appropriate such as satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), scientific probes, microscopes, telescopes, modern video and image libraries, weather stations, fossil and rock kits, bar magnets, coiled springs, wave simulators, tectonic plate models, and planetary globes;

(G) organize, analyze, evaluate, make inferences, and predict trends from data;

(H) use mathematical procedures such as algebra, statistics, scientific notation, and significant figures to analyze data using the International System (SI) units; and

(I) communicate valid conclusions supported by data using several formats such as technical reports, lab reports, labeled drawings, graphic organizers, journals, presentations, and technical posters.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and public policy;

(E) explore careers and collaboration among scientists in Earth and space sciences; and

(F) learn and understand the contributions of scientists to the historical development of Earth and space sciences.

(4) Earth in space and time. The student knows how Earth-based and space-based astronomical observations reveal differing theories about the structure, scale, composition, origin, and history of the universe. The student is expected to:

(A) **Chapter 4** evaluate the evidence concerning the Big Bang model such as red shift and cosmic microwave background radiation and current theories of the evolution of the universe, including estimates for the age of the universe;

(B) **3.3 & 6.3** explain how the Sun and other stars transform matter into energy through nuclear fusion; and

(C) investigate the process by which a supernova can lead to the formation of successive generation stars and planets.

(5) Earth in space and time. The student understands the solar nebular accretionary disk model. The student is expected to:

(A) analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets;

(B) investigate thermal energy sources, including kinetic heat of impact accretion, gravitational compression, and radioactive decay, which are thought to allow protoplanet differentiation into layers;

(C) contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud;

(D) explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal;

(E) compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life; and

(F) compare extra-solar planets with planets in our solar system and describe how such planets are detected.