

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.

§112.33. Astronomy, Beginning with School Year 2010-2011 (One Credit).

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Suggested prerequisite: one unit of high school science. This course is recommended for students in Grade 11 or 12.

(b) Introduction.

(1) Astronomy. In Astronomy, students conduct laboratory and field investigations, use scientific methods, and make informed decisions using critical thinking and scientific problem solving. Students study the following topics: astronomy in civilization, patterns and objects in the sky, our place in space, the moon, reasons for the seasons, planets, the sun, stars, galaxies, cosmology, and space exploration. Students who successfully complete Astronomy will acquire knowledge within a conceptual framework, conduct observations of the sky, work collaboratively, and develop critical-thinking skills.

(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) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

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

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

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

(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) plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect data and make measurements with accuracy and precision;

(G) organize, analyze, evaluate, make inferences, and predict trends from data, including making new revised hypotheses when appropriate;

(H) communicate valid conclusions in writing, oral presentations, and through collaborative projects; and

(I) use astronomical technology such as telescopes, binoculars, sextants, computers, and software.

(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 the environment; and

(E) describe the connection between astronomy and future careers.

(4) Science concepts. The student recognizes the importance and uses of astronomy in civilization. The student is expected to:

(A) research and describe the use of astronomy in ancient civilizations such as the Egyptians, Mayans, Aztecs, Europeans, and the native Americans;

(B) **2.1, Chapter 4, 7.4** research and describe the contributions of scientists to our changing understanding of astronomy, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, Newton, Einstein, and Hubble, and the contribution of women astronomers, including Maria Mitchell and Henrietta Swan Leavitt;

Simon Dalley comment: Other women astronomers of note are Jocelyn Bell (discovered pulsars) and Vera Rubin (catalogued rotation curves of galaxies, thus evidence for dark matter).

(C) describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation; and

(D) explain the contributions of modern astronomy to today's society, including the identification of potential asteroid/comet impact hazards and the Sun's effects on communication, navigation, and high-tech devices.

(5) Science concepts. The student develops a familiarity with the sky. The student is expected to:

(A) observe and record the apparent movement of the Sun and Moon during the day;

(B) observe and record the apparent movement of the Moon, planets, and stars in the nighttime sky; and

(C) recognize and identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations of the zodiac.

(6) Science concepts. The student knows our place in space. The student is expected to:

(A) compare and contrast the scale, size, and distance of the Sun, Earth, and Moon system through the use of data and modeling;

(B) compare and contrast the scale, size, and distance of objects in the solar system such as the Sun and planets through the use of data and modeling;

(C) **4.4** examine the scale, size, and distance of the stars, Milky Way, and other galaxies through the use of data and modeling;

(D) relate apparent versus absolute magnitude to the distances of celestial objects; and

(E) **4.4** demonstrate the use of units of measurement in astronomy, including Astronomical Units and light years.

(7) Science concepts. The student knows the role of the Moon in the Sun, Earth, and Moon system. The student is expected to:

(A) observe and record data about lunar phases and use that information to model the Sun, Earth, and Moon system;

(B) illustrate the cause of lunar phases by showing positions of the Moon relative to Earth and the Sun for each phase, including new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter, and waning crescent;

(C) identify and differentiate the causes of lunar and solar eclipses, including differentiating between lunar phases and eclipses; and

(D) identify the effects of the Moon on tides.

(8) Science concepts. The student knows the reasons for the seasons. The student is expected to:

(A) recognize that seasons are caused by the tilt of Earth's axis;

(B) explain how latitudinal position affects the length of day and night throughout the year;

(C) recognize that the angle of incidence of sunlight determines the concentration of solar energy received on Earth at a particular location; and

(D) examine the relationship of the seasons to equinoxes, solstices, the tropics, and the equator.

(9) Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to:

(A) compare and contrast the factors essential to life on Earth such as temperature, water, mass, and gases to conditions on other planets;

(B) compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, and geological activity;

(C) **2.2 relate the role of Newton's law of universal gravitation to the motion of the planets around the Sun and to the motion of natural and artificial satellites around the planets;** and

(D) explore the origins and significance of small solar system bodies, including asteroids, comets, and Kuiper belt objects.

(10) Science concepts. The student knows the role of the Sun as the star in our solar system. The student is expected to:

(A) identify the approximate mass, size, motion, temperature, structure, and composition of the Sun;

(B) **6.3** distinguish between nuclear fusion and nuclear fission, and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium;

(C) describe the eleven-year solar cycle and the significance of sunspots; and

(D) analyze solar magnetic storm activity, including coronal mass ejections, prominences, flares, and sunspots.

(11) Science concepts. The student knows the characteristics and life cycle of stars. The student is expected to:

(A) identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition;

(B) characterize star formation in stellar nurseries from giant molecular clouds, to protostars, to the development of main sequence stars;

(C) evaluate the relationship between mass and fusion on the dying process and properties of stars;

(D) differentiate among the end states of stars, including white dwarfs, neutron stars, and **4.2** black holes;

(E) compare how the mass and gravity of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole;

(F) **4.4** relate the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; and

(G) use the Hertzsprung-Russell diagram to plot and examine the life cycle of stars from birth to death.

(12) Science concepts. The student knows the variety and properties of galaxies. The student is expected to:

(A) describe characteristics of galaxies;

(B) **4.4** recognize the type, structure, and components of our Milky Way galaxy and location of our solar system within it; and

(C) compare and contrast the different types of galaxies, including spiral, elliptical, irregular, and dwarf.

(13) Science concepts. The student knows the scientific theories of cosmology. The student is expected to:

(A) **4.3 & 4.4** research and describe the historical development of the Big Bang Theory, including red shift, cosmic microwave background radiation, and other supporting evidence;

(B) research and describe current theories of the evolution of the universe, including estimates for the age of the universe; and

(C) **4.3, 4.4 & 7.4** research and describe scientific hypotheses of the fate of the universe, including open and closed universes and the role of dark matter and dark energy.

(14) Science concepts. The student recognizes the benefits and challenges of space exploration to the study of the universe. The student is expected to:

(A) identify and explain the contributions of human space flight and future plans and challenges;

(B) recognize the advancement of knowledge in astronomy through robotic space flight;

(C) analyze the importance of ground-based technology in astronomical studies;

(D) **4.4** recognize the importance of space telescopes to the collection of astronomical data across the electromagnetic spectrum; and

(E) demonstrate an awareness of new developments and discoveries in astronomy.