Texas Science

Astronomy (2021): Grade 12

Adopted 2021

The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to explain phenomena or design solutions using appropriate tools and models. The student is expected to: AST.1

- **A.** ask questions and define problems based on observations or information from text, phenomena, models, or investigations; AST.1.A
- **B.** apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; AST.1.B
- **C.** use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; AST.1.C
- **D.** use appropriate tools such as gnomons; sundials; Planisphere; star charts; globe of the Earth; diffraction gratings; spectroscopes; color filters; lenses of multiple focal lengths; concave, plane, and convex mirrors; binoculars; telescopes; celestial sphere; online astronomical databases; and online access to observatories; AST.1.D
- **E.** collect quantitative data using the International System of Units (SI) and qualitative data as evidence; AST.1.E
- **F.** organize quantitative and qualitative data using graphs, charts, spreadsheets, and computer software; AST.1.F
- **G.** develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and AST.1.G
- **H.** distinguish between scientific hypotheses, theories, and laws. AST.1.H

The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate de
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- **A.** identify advantages and limitations of models such as their size, scale, properties, and materials; AST.2.A
- **B.** analyze data by identifying significant statistical features, patterns, sources of error, and limitations; AST.2.B
- **C.** use mathematical calculations to assess quantitative relationships in data; and AST.2.C

evaluate experimental and engineering designs. AST.2.D

The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to: AST.3	**A.** develop explanations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories; AST.3.A
	B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and AST.3.B
	C. engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. AST.3.C
The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to: AST.4	**A.** analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student; AST.4.A
	B. relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and AST.4.B
	C. research and explore resources such as museums, planetariums, observatories, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers. AST.4.C
The student understands how astronomy influenced and advanced civilizations. The student is expected to: AST.5	**A.** evaluate and communicate how ancient civilizations developed models of the universe using astronomical structures, instruments, and tools such as the astrolabe, gnomons, and charts and how those models influenced society, time keeping, and navigation; AST.5.A
	B. research and evaluate the contributions of scientists, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, and Newton, as astronomy progressed from a geocentric model to a heliocentric model; and AST.5.B
	C. describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation. AST.5.C
The student conducts and explains astronomical observations made from the point of reference of Earth. The student is expected to: AST.6	**A.** observe, record, and analyze the apparent movement of the Sun, Moon, and stars and predict sunrise and sunset; AST.6.A
	B. observe the movement of planets throughout the year and measure how their positions change relative to the constellations; AST.6.B
	C. identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations along the ecliptic and describe their importance; and AST.6.C
	D. understand the difference between astronomy and astrology, the reasons for their historical conflation, and their eventual separation. AST.6.D

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The student knows our relative place in the solar system. The student is expected to: AST.7	**A.** demonstrate the use of units of measurement in astronomy, including astronomical units and light years, minutes, and seconds; AST.7.A
	B. model the scale, size, and distances of the Sun, Earth, and Moon system and identify the limitations of physical models; and AST.7.B
	C. model the scale, sizes, and distances of the Sun and the planets in our solar system and identify the limitations of physical models. AST.7.C
The student observes and models the interactions within the Sun, Earth, and Moon system. The student is expected to: AST.8	**A.** model how the orbit and relative position of the Moon cause lunar phases and predict the timing of moonrise and moonset during each phase; AST.8.A
	B. model how the orbit and relative position of the Moon cause lunar and solar eclipses; and AST.8.B
	C. examine and investigate the dynamics of tides using the Sun, Earth, and Moon model. AST.8.C
The student models the cause of planetary seasons. The student is expected to: AST.9	**A.** examine the relationship of a planet's axial tilt to its potential seasons; AST.9.A
	B. predict how changing latitudinal position affects the length of day and night throughout a planet's orbital year; AST.9.B
	C. investigate the relationship between a planet's axial tilt, angle of incidence of sunlight, and concentration of solar energy; and AST.9.C
	D. explain the significance of Earth's solstices and equinoxes. AST.9.D
The student knows how astronomical tools collect and record information about celestial objects. The student is expected to: AST.10	**A.** investigate the use of black body radiation curves and emission, absorption, and continuous spectra in the identification and classification of celestial objects; AST.10.A
	B. calculate the relative light-gathering power of different-sized telescopes to compare telescopes for different applications; AST.10.B
	C. analyze the importance and limitations of optical, infrared, and radio telescopes, gravitational wave detectors, and other ground-based technology; and AST.10.C
	D. analyze the importance and limitations of space telescopes in the collection of astronomical data across the electromagnetic spectrum. AST.10.D
The student uses models to explain the formation, development, organization, and sig sy	**A.** relate Newton's law of universal gravitation and Kepler's laws of planetary motion to the formation and motion of the planets and their satellites; AST.11.A
	B. explore and communicate the origins and significance of planets, planetary rings, satellites, asteroids, comets, Oort cloud, and Kuiper belt objects; AST.11.B

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student is expected to: AST.11	**C.** compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, magnetic fields, and geological activity; and AST.11.C
	D. compare the factors essential to life on Earth such as temperature, water, gases, and gravitational and magnetic fields to conditions on other planets and their satellites. AST.11.D
The student knows that our Sun serves as a model for stellar activity. The student is expected to: AST.12	**A.** identify the approximate mass, size, motion, temperature, structure, and composition of the Sun; AST.12.A
	B. distinguish between nuclear fusion and nuclear fission and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium; AST.12.B
	C. describe the eleven-year solar cycle and the significance of sunspots; and AST.12.C
	D. analyze the origins and effects of space weather, including the solar wind, coronal mass ejections, prominences, flares, and sunspots. AST.12.D
The student understands the characteristics and life cycle of stars. The student is expected to: AST.13	**A.** identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition; AST.13.A
	B. describe and communicate star formation from nebulae to protostars to the development of main sequence stars; AST.13.B
	C. evaluate the relationship between mass and fusion on stellar evolution; AST.13.C
	D. compare how the mass of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole; AST.13.D
	E. describe the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; AST.13.E
	F. use the Hertzsprung-Russell diagram to classify stars and plot and examine the life cycle of stars from birth to death; AST.13.F
	G. illustrate how astronomers use geometric parallax to determine stellar distances and intrinsic luminosities; and AST.13.G
	H. describe how stellar distances are determined by comparing apparent brightness and intrinsic luminosity when using spectroscopic parallax and the Leavitt relation for variable stars. AST.13.H
The student knows the structure of the universe and our relative place in it. ex	**A.** illustrate the structure and components of our Milky Way galaxy and model the size, location, and movement of our solar system within it; AST.14.A
	compare spiral, elliptical, irregular, dwarf, and active galaxies; AST.14.B

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	C. develop and use models to explain how galactic evolution occurs through mergers and collisions; AST.14.C
	D. describe the Local Group and its relation to larger-scale structures in the universe; and AST.14.D
	E. evaluate the indirect evidence for the existence of dark matter. AST.14.E
The student knows the scientific theories of cosmology. The student is expected to: AST.15	**A.** describe and evaluate the historical development of evidence supporting the Big Bang Theory; AST.15.A
	B. evaluate the limits of observational astronomy methods used to formulate the distance ladder; AST.15.B
	C. evaluate the indirect evidence for the existence of dark energy; AST.15.C
	D. describe the current scientific understanding of the evolution of the universe, including estimates for the age of the universe; and AST.15.D
	E. describe current scientific hypotheses about the fate of the universe, including open and closed universes. AST.15.E
The student understands the benefits and challenges of expanding our knowledge of the universe. The student is expected to: AST.16	**A.** describe and communicate the historical development of human space flight and its challenges; AST.16.A
	B. describe and communicate the uses and challenges of robotic space flight; AST.16.B
	C. evaluate the evidence of the existence of habitable zones and potentially habitable planetary bodies in extrasolar planetary systems; AST.16.C
	D. evaluate the impact on astronomy from light pollution, radio interference, and space debris; AST.16.D
	E. examine and describe current developments and discoveries in astronomy; and AST.16.E
	F. explore and explain careers that involve astronomy, space exploration, and the technologies developed through them. AST.16.F