Science Georgia Standards of Excellence

SCIENCE - Astronomy

The Science Georgia Standards of Excellence are designed to provide foundational knowledge and skills for all students to develop proficiency in science. The Project 2061's *Benchmarks for Science Literacy* and the follow up work, *A Framework for K-12 Science Education* were used as the core of the standards to determine appropriate content and process skills for students. The Science Georgia Standards of Excellence focus on a limited number of core disciplinary ideas and crosscutting concepts which build from Kindergarten to high school. The standards are written with the core knowledge to be mastered integrated with the science and engineering practices needed to engage in scientific inquiry and engineering design. Crosscutting concepts are used to make connections across different science disciplines.

The Science Georgia Standards of Excellence drive instruction. Hands-on, student-centered, and inquiry-based approaches should be the emphasis of instruction. The standards are a required minimum set of expectations that show proficiency in science. However, instruction can extend beyond these minimum expectations to meet student needs.

Science consists of a way of thinking and investigating, as well a growing body of knowledge about the natural world. To become literate in science, students need to possess sufficient understanding of fundamental science content knowledge, the ability to engage in the science and engineering practices, and to use scientific and technological information correctly. Technology should be infused into the curriculum and the safety of the student should always be foremost in instruction.

This course will provide the student with an introduction to the concepts of modern astronomy, the origin and history of the Universe, and the formation of the Earth and the solar system. Students will compare the Earth's properties with those of the other planets and explore how the heavens have influenced human thought and action. The course gives a description of astronomical phenomena using the laws of physics. The course treats many standard topics including planets, stars, the Milky Way and other galaxies, black holes to more esoteric questions concerning the origin of the universe and its evolution and fate. Although largely descriptive, the course will occasionally require the use of sophomore-high level mathematics. Laboratory exercises include experiments in light properties, measurement of radiation from celestial sources, and observations at local observatories and/or planetariums.

SAST1. Obtain, evaluate, and communicate information to assess the validity of historical theories of astronomy.

a. Ask questions to investigate the daily/seasonal motions of the sky and communicate the significance of constellations, for navigation and time-keeping.
(*Clarification statement*: Compare and contrast astronomy and astrology and describe how the zodiac relates to the motions of solar system objects.)

b. Obtain, evaluate and communicate information about how ancient structures, instruments, philosophies and civilizations influenced ancient astronomy.
(*Clarification statement:* Philosophies include but are not limited to geocentric theory, Aristotelian physics, and the Ptolemaic model with epicycles.)

c. Construct an argument based on evidence to support the scientific claims made by the heliocentric model.
(*Clarification statement*: Include observational evidence from Galileo's work, and the ideas of Copernicus, Kepler, and Newton.)

d. Use mathematics and computational thinking to relate Kepler's Laws to Newton's Law of Gravitation.

e. Construct an explanation for how technological advances in the design of reflecting and refracting telescopes have improved our ability to study the universe.
(*Clarification statement*: The focus is on the historical use of optical telescopes utilizing only the visible light spectrum.

SAST2. Obtain, evaluate, and communicate information to explain astronomical observations made from the point of reference of Earth.

a. Develop and use models to evaluate the relationship between the relative positions of the Earth, Moon and Sun and observable phenomena.
(*Clarification statement:* This includes moon phases, eclipses, tides, and seasons.)

b. Plan and carry out an investigation using the celestial sphere to explain how latitude and time of year affect visibility of constellations and other celestial objects.

c. Develop and use models of relative orbital motion of planets within our solar system to explain retrograde motion.

d. Use mathematics and computational thinking to explain the relationship between the properties of light and the vast distances in the cosmos.
(*Clarification statement*: This includes but is not limited to the Doppler Effect, cosmological red shifts, parsecs, light years, and astronomical units.)

e. Plan and carry out an investigation to analyze the electromagnetic spectrum and spectroscopic data to obtain information about the inherent properties and motions of objects.
(*Clarification statement*: Consider the use of diffraction gratings to analyze spectroscopic wavelength data along with other quantitative telescopic data.)

SAST3. Obtain, evaluate, and communicate information to illustrate the formation of the solar system and the properties of celestial objects within it.

a. Develop and use models to explain the formation of the solar system.
(*Clarification statement*: This includes the nebular theory.)

b. Develop and use models to explain the chemical composition and characteristics of the Sun and other solar system objects.
(*Clarification statement*: This should include addressing the role of nuclear fusion in the formation of elements in the sun and the role that hydrostatic equilibrium plays in the formation of different objects in the solar system.)

c. Ask questions to investigate and communicate major properties of our solar system bodies and the zones they inhabit.
(*Clarification statement*: This includes planets, dwarf planets, major moons, asteroid belt, comets, Kuiper belt, and the Öort cloud.)

SAST4. Obtain, evaluate, and communicate information to describe the scientific view of the origin of the universe, the evolution of matter, and the development of galaxies.

a. Construct an argument from evidence in support of the Big Bang theory.
(*Clarification statement*: This includes but is not limited to the cosmological principle, cosmic microwave background radiation, and space-time expansion.)

b. Use models to describe the conditions of the early universe that led to the formation and evolution of matter as well as the birth of the first stars and galaxies.

c. Construct an explanation using indirect evidence to support the existence of dark matter and dark energy.

d. Develop and use models to relate how galactic evolution occurs through mergers and collisions.

SAST5. Obtain, evaluate, and communicate information about the connections between mass, gravity and fusion with respect to the life cycle of stars.

a. Develop and use models to explain the process of stellar evolution from star birth to star death, including binary systems.

b. Construct an argument based on evidence from the Hertzsprung-Russell diagram to assess the properties of stars, including density, luminosity, temperature, rates of fusion, and spectral class.

c. Ask questions to evaluate evidence that predicts the lifespan and final stage of stellar evolution based on mass.
(*Clarification statement*: Include stellar remnants and events such as neutron stars, pulsars, black holes, supernovae.)

d. Construct an argument based on evidence that explores the connections among various cosmic phenomena and leading theories.

SAST6. Obtain, evaluate, and communicate information to discuss how the past, current, and future explorations of space impact our investigations of the connections between cosmic phenomena and conditions necessary for life.

a. Construct an argument based on evidence of the significance of historical and future space exploration as they relate to leaps in technology, cultural cooperation, knowledge, and inspiration.
(*Clarification statement*: Historical space exploration begins with Sputnik and continues to the present day, including possible future extrasolar exploration, space stations, and colonization.)

b. Analyze and interpret telescopic data of various electromagnetic spectra in order to evaluate the uses and advantages of the data from each.
(*Clarification statement*: This includes but is not limited to atmospheric analysis, solar monitoring, and exoplanet detection.)

c. Construct an explanation for the existence and importance of habitable zones, habitable planetary bodies, and possible signatures of life in our own and in other solar systems.

d. Construct an explanation of how astronomical and planetary hazards and global atmospheric changes have impacted the evolution of life on Earth.
(*Clarification statement*: This includes but is not limited to asteroid impacts, changes in solar radiation, and gamma ray bursts.)