

## Astronomy Curriculum

The Georgia Performance Standards are designed to provide students with the knowledge and skills for proficiency in science. The Project 2061's *Benchmarks for Science Literacy* is used as the core of the curriculum to determine appropriate content and process skills for students. The GPS is also aligned to the National Research Council's *National Science Education Standards*. Technology is infused into the curriculum. The relationship between science, our environment, and our everyday world is crucial to each student's success and should be emphasized.

The performance standards should drive instruction. Hands-on, student-centered, and inquiry-based approaches should be the emphasis of instruction. This curriculum is intended as a required curriculum that would show proficiency in science, and instruction should extend beyond the curriculum to meet the student needs.

The hands-on nature of the science curriculum standards increases the need for teachers to use appropriate precautions in the laboratory and field. The guidelines for the safe use, storage, and disposal of chemicals must be observed. Safety of the student should always be foremost in science instruction.

Science consists of a way of thinking and investigating, and includes a growing body of knowledge about the natural world. To become literate in science, therefore, students need to acquire understandings of both the **Characteristics of Science** and its **Content**. The Georgia Performance Standards for Science require that instruction be organized so that these are treated together. Therefore, **A CONTENT STANDARD IS NOT MET UNLESS APPLICABLE CHARACTERISTICS OF SCIENCE ARE ALSO ADDRESSED AT THE SAME TIME**. For this reason they are presented as co-requisites.

An explanation of the coding of the science GPS is attached.

This Performance Standards document includes four major components. They are:

**The Standards for Georgia Science Courses.** The Characteristics of Science co-requisite standards are listed first followed by the Content co-requisite standards. Each Standard is followed by elements that indicate the specific learning goals associated with it.

**Tasks that students should be able to perform during or by the end of the course.** These tasks are keyed to the relevant Standards. Some of these can serve as activities that will help students achieve the learning goals of the Standard while others can be used to assess student learning. Many of these tasks can serve both purposes.

**Samples of student work.** As a way of indicating what it takes to meet a Standard, examples of successful student work are provided. Many of these illustrate how student work can bridge the Content and Characteristics of Science Standards. The Georgia DOE Standards web site will continue to add samples as they are identified and teachers are encouraged to submit examples from their own classroom experiences.

**Teacher Commentary.** Teacher commentary is meant to open the pathways of communication between students and the classroom teacher. Showing students why they did or did not meet a standard enables them to take ownership of their own learning.

Georgia Performance Science Standards-- Explanation of Coding

Characteristics of Science Standards

**SKCS1**

Science Kindergarten Characteristics of Science Standard #1

**S8CS2**

Science Grade 8 Characteristics of Science Standard #2

**SCSh8**

Science Characteristics of Science high school Standard #8

Content Standards

**S5P3**

Science Grade 5 Physical Science Standard #3

**S4E2**

Science Grade 4 Earth Science Standard #2

**S7L4**

Science Grade 7 Life Science Standard #4

**SC1**

Science Chemistry Standard #1

**SB4**

Science Biology Standard #4

**SPS6**

Science Physical Science Standard #6

**SP3**

Science Physics Standard #3

**SAST2**

Science ASTronomy Standard #2

## **Astronomy**

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.

## **Co-Requisite – Characteristics of Science**

### **Habits of Mind**

- SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.**
- Exhibit the above traits in their own scientific activities.
  - Recognize that different explanations often can be given for the same evidence.
  - Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.
- SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.**
- Follow correct procedures for use of scientific apparatus.
  - Demonstrate appropriate technique in all laboratory situations.
  - Follow correct protocol for identifying and reporting safety problems and violations.
- SCSh3. Students will identify and investigate problems scientifically.**
- Suggest reasonable hypotheses for identified problems.
  - Develop procedures for solving scientific problems.
  - Collect, organize and record appropriate data.
  - Graphically compare and analyze data points and/or summary statistics.
  - Develop reasonable conclusions based on data collected.
  - Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

- SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.**
- Develop and use systematic procedures for recording and organizing information.
  - Use technology to produce tables and graphs.
  - Use technology to develop, test, and revise experimental or mathematical models.
- SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.**
- Trace the source on any large disparity between estimated and calculated answers to problems.
  - Consider possible effects of measurement errors on calculations.
  - Recognize the relationship between accuracy and precision.
  - Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.
  - Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.
- SCSh6. Students will communicate scientific investigations and information clearly.**
- Write clear, coherent laboratory reports related to scientific investigations.
  - Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
  - Use data as evidence to support scientific arguments and claims in written or oral presentations.
  - Participate in group discussions of scientific investigation and current scientific issues.

### **The Nature of Science**

**SCSh7. Students analyze how scientific knowledge is developed.**

Students recognize that:

- The universe is a vast single system in which the basic principles are the same everywhere.
- Universal principles are discovered through observation and experimental verification.
- From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.
- Hypotheses often cause scientists to develop new experiments that produce additional data.
- Testing, revising, and occasionally rejecting new and old theories never ends.

**SCSh8. Students will understand important features of the process of scientific inquiry.**

Students will apply the following to inquiry learning practices:

- a. Scientific investigators control the conditions of their experiments in order to produce valuable data.
- b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations' hypotheses, observations, data analyses, and interpretations.
- c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.
- d. The merit of a new theory is judged by how well scientific data are explained by the new theory.
- e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.
- f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

**Reading Standard Comment**

After the elementary years, students are seriously engaged in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas *in context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

**SCSh9. Students will enhance reading in all curriculum areas by:**

- a. Reading in all curriculum areas
  - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
  - Read both informational and fictional texts in a variety of genres and modes of discourse.
  - Read technical texts related to various subject areas.
- b. Discussing books
  - Discuss messages and themes from books in all subject areas.
  - Respond to a variety of texts in multiple modes of discourse.
  - Relate messages and themes from one subject area to messages and themes in another area.
  - Evaluate the merit of texts in every subject discipline.
  - Examine author's purpose in writing.
  - Recognize the features of disciplinary texts.
- c. Building vocabulary knowledge
  - Demonstrate an understanding of contextual vocabulary in various subjects.
  - Use content vocabulary in writing and speaking.
  - Explore understanding of new words found in subject area texts.
- d. Establishing context
  - Explore life experiences related to subject area content.

- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

## **Co- Requisite -Content**

**SAST1. Students will explain the tools used by astronomers to study electromagnetic radiation to determine composition, motions, and other physical attributes of astronomical objects.**

- Explain the challenges faced by astronomers due to the properties of light and the vast distances in the cosmos.
- Evaluate the types of telescopes used by astronomers for examining different frequencies of electromagnetic radiation and compare and contrast the uses and advantages of each (e.g. radio, visible, gamma ray, reflector, and refractor).
- Mathematically apply Newtonian gravity to celestial bodies to determine their masses and explain their motion (e.g. Kepler's Laws)
- Discuss how spectroscopy provides information about the inherent properties and motions of objects.
- Quantitatively analyze data from telescopes (e.g. spectra, multi-wavelength photometry, and images) and/or other astronomical sources (e.g. tide tables, sky charts).

**SAST2. Students will describe the scientific view of the origin of the universe, the evolution of matter and the development of resulting celestial objects.**

- Outline the main arguments and evidence in support of the standard cosmological model. (e.g. elements, solar systems, and universe)
- Describe the life cycle of a star and explain the role gravity and mass play in the brightness, life span, and end-stages of stars.
- Compare and contrast the major properties of the components of our solar system.

**SAST3. Students will describe and explain the celestial sphere and astronomical observations made from the point of reference of the Earth.**

- Evaluate the effects of the relative positions of the Earth, moon, and sun on observable phenomena, e.g. phases of the moon, eclipses, seasons, and diurnal cycles.
- Describe how latitude and time of the year affect visibility of constellations.
- Predict visibility of planets (major and minor) in the solar system based on relative orbital motion.



**SAST4. Students analyze the dynamic nature of astronomy by comparing and contrasting evidence supporting current views of the universe with historical views.**

- a. Evaluate the impact that technological advances, as an agent of change, have had on our modern view of the solar system and universe.
- b. Explain the relevance of experimental contributions of scientists to the advancement of the field of astronomy.

**SAST5: Students will evaluate the significance of energy transfers and energy transformations in understanding the universe.**

- a. Relate nuclear fusion reactions and mass-energy equivalence to the life cycle of stars.
- b. Explain the relationship between the energy produced by fusion in stars to the luminosity.
- c. Analyze the energy relationships between the mass, power output, and life span of stars.
- d. Describe energy transfers and transformations associated with the motion and interactions of celestial bodies (e.g. orbits, binary pulsars, meteors, black holes, and galaxy mergers).

**SAST6: Students will explore connections between cosmic phenomena and conditions necessary for life.**

- a. Characterize the habitable zone in solar systems and habitable planetary bodies in our own and other solar systems.
- b. Describe the tools and techniques used to identify extrasolar planets and explore extrasolar planetary atmospheres.
- c. Describe signatures of life on other worlds and early Earth.
- d. Explain how astronomical hazards and global atmospheric changes have impacted the evolution of life on Earth.