

Physics 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 emphases 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 materials 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.

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. All 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****

Physics

The Physics curriculum is designed to continue student investigations of the physical sciences that began in grades K-8 and provide students the necessary skills to be proficient in physics. This curriculum includes more abstract concepts such as interactions of matter and energy, **velocity**, **acceleration**, **force**, **energy**, **momentum**, and **charge**. Students investigate physics concepts through experience in laboratories and field work using the processes of inquiry.

Major Concepts/ Skills:	Concepts/Skills to Maintain:
Kinematics	Characteristics of Science
Energy and its transformations	Records investigations clearly and accurately
Electricity	Uses scientific tools
Magnetism	Interprets graphs, tables, and charts
Wave properties	Writes clearly
	Uses proper units
	Organizes data into graphs, tables, and charts
	Analyzes scientific data via calculations and inference
	Recognizes the importance of explaining data with precision and accuracy
	Uses models
	Asks quality questions
	Uses technology
	Uses safety techniques

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.

- f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- a. Develop and use systematic procedures for recording and organizing information.
- b. Use technology to produce tables and graphs.
- c. 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.

- a. Trace the source on any large disparity between estimated and calculated answers to problems.
- b. Consider possible effects of measurement errors on calculations.
- c. Recognize the relationship between accuracy and precision.
- d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.
- e. 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.

- a. Write clear, coherent laboratory reports related to scientific investigations.
- b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data
- c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
- d. Participate in group discussions of scientific investigation and current scientific issues.

The Nature of Science

SCSh7. Students will analyze how scientific knowledge is developed.

Students will recognize that:

- a. The universe is a vast single system in which the basic principles are the same everywhere.
- b. Universal principles are discovered through observation and experimental verification.
- c. 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.
- d. Hypotheses often cause scientists to develop new experiments that produce additional data.
- e. 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

SP1. Students will analyze the relationships between force, mass, gravity, and the motion of objects.

- a. Calculate average velocity, instantaneous velocity, and acceleration in a given frame of reference.
- b. Compare and contrast scalar and vector quantities.
- c. Compare graphically and algebraically the relationships among position, velocity, acceleration, and time.
- d. Measure and calculate the magnitude of frictional forces and Newton's three Laws of Motion.
- e. Measure and calculate the magnitude of gravitational forces.
- f. Measure and calculate two-dimensional motion (projectile and circular) by using component vectors.
- g. Measure and calculate centripetal force.
- h. Determine the conditions required to maintain a body in a state of static equilibrium.

SP2. Students will evaluate the significance of energy in understanding the structure of matter and the universe.

- a. Relate the energy produced through fission and fusion by stars as a driving force in the universe.
- b. Explain how the instability of radioactive isotopes results in spontaneous nuclear reactions.

SP3. Students will evaluate the forms and transformations of energy.

- a. Analyze, evaluate, and apply the principle of conservation of energy and measure the components of work-energy theorem by
 - describing total energy in a closed system.
 - identifying different types of potential energy.

- calculating kinetic energy given mass and velocity.
 - relating transformations between potential and kinetic energy.
- b. Explain the relationship between matter and energy.
 - c. Measure and calculate the vector nature of momentum.
 - d. Compare and contrast elastic and inelastic collisions.
 - e. Demonstrate the factors required to produce a change in momentum.
 - f. Analyze the relationship between temperature, internal energy, and work done in a physical system.
 - g. Analyze and measure power.

SP4. Students will analyze the properties and applications of waves.

- a. Explain the processes that results in the production and energy transfer of electromagnetic waves.
- b. Experimentally determine the behavior of waves in various media in terms of reflection, refraction, and diffraction of waves.
- c. Explain the relationship between the phenomena of interference and the principle of superposition.
- d. Demonstrate the transfer of energy through different mediums by mechanical waves.
- e. Determine the location and nature of images formed by the reflection or refraction of light.

SP5. Students will evaluate relationships between electrical and magnetic forces.

- a. Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy.
- b. Determine the relationship among potential difference, current, and resistance in a direct current circuit.
- c. Determine equivalent resistances in series and parallel circuits.
- d. Determine the relationship between moving electric charges and magnetic fields.

SP6. The student will describe the corrections to Newtonian physics given by quantum mechanics and relativity when matter is very small, moving fast compared to the speed of light, or very large.

- a. Explain matter as a particle and as a wave.
- b. Describe the Uncertainty Principle.
- c. Explain the differences in time, space, and mass measurements by two observers when one is in a frame of reference moving at constant velocity parallel to one of the coordinate axes of the other observer's frame of reference if the constant velocity is greater than one tenth the speed of light.
- d. Describe the gravitational field surrounding a large mass and its effect on a ray of light.