

Biology 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 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****

Biology

The Biology curriculum is designed to continue student investigations of the life sciences that began in grades K-8 and provide students the necessary skills to be proficient in biology. This curriculum includes more abstract concepts such as the interdependence of organisms, the relationship of matter, energy, and organization in living systems, the behavior of organisms, and biological evolution. Students investigate biological concepts through experience in laboratories and field work using the processes of inquiry.

| Major Concepts/ Skills: | Concepts/Skills to Maintain: |
|---|--|
| Classification to the Six Kingdom level | Characteristics of Science |
| Matter-Energy Relationships | Records investigations clearly and accurately |
| Cellular Function and Structure | Uses scientific tools |
| DNA/RNA | Interprets graphs, tables, and charts |
| Homeostasis | Writes clearly |
| Plant/Animal Characteristics | Uses proper units |
| Genes and Successive Generations | Organizes data into graphs, tables, and charts |
| Heredity | Analyzes scientific data via calculations and inference |
| Ecosystems | Uses models |
| Biological Evolution | Asks quality questions |
| | Uses technology |
| | Uses safety techniques |
| | Recognizes the importance of explaining data with precision and accuracy |

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.

- d. Graphically compare and analyze data points and/or summary statistics.
- e. 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 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 analyze how scientific knowledge is developed.

Students 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

SB1. Students will analyze the nature of the relationships between structures and functions in living cells.

- a. Explain the role of cell organelles for both prokaryotic and eukaryotic cells, including the cell membrane, in maintaining homeostasis and cell reproduction.
- b. Explain how enzymes function as catalysts.
- c. Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic acids).
- d. Explain the impact of water on life processes (i.e., osmosis, diffusion).

SB2. Students will analyze how biological traits are passed on to successive generations.

- a. Distinguish between DNA and RNA.
- b. Explain the role of DNA in storing and transmitting cellular information.
- c. Using Mendel's laws, explain the role of meiosis in reproductive variability.
- d. Describe the relationships between changes in DNA and potential appearance of new traits including
 - Alterations during replication.
 - Insertions
 - Deletions
 - Substitutions
 - Mutagenic factors that can alter DNA.
 - High energy radiation (x-rays and ultraviolet)
 - Chemical
- e. Compare the advantages of sexual reproduction and asexual reproduction in different situations.

- f. Examine the use of DNA technology in forensics, medicine, and agriculture.

SB3. Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.

- a. Explain the cycling of energy through the processes of photosynthesis and respiration.
- b. Compare how structures and function vary between the six kingdoms (archaebacteria, eubacteria, protists, fungi, plants, and animals).
- c. Examine the evolutionary basis of modern classification systems.
- d. Compare and contrast viruses with living organisms.

SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

- a. Investigate the relationships among organisms, populations, communities, ecosystems, and biomes.
- b. Explain the flow of matter and energy through ecosystems by
 - Arranging components of a food chain according to energy flow.
 - Comparing the quantity of energy in the steps of an energy pyramid.
 - Explaining the need for cycling of major nutrients (C, O, H, N, P).
- c. Relate environmental conditions to successional changes in ecosystems.
- d. Assess and explain human activities that influence and modify the environment such as global warming, population growth, pesticide use, and water and power consumption.
- e. Relate plant adaptations, including tropisms, to the ability to survive stressful environmental conditions.
- f. Relate animal adaptations, including behaviors, to the ability to survive stressful environmental conditions.

SB5. Students will evaluate the role of natural selection in the development of the theory of evolution.

- a. Trace the history of the theory.
- b. Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution.
- c. Explain how fossil and biochemical evidence support the theory.
- d. Relate natural selection to changes in organisms.
- e. Recognize the role of evolution to biological resistance (pesticide and antibiotic resistance).