Entomology 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 **K**indergarten **C**haracteristics of **S**cience Standard #**1**

S8CS2
Science Grade **8** **C**haracteristics of **S**cience Standard #**2**

SCSh8
Science **C**haracteristics of **S**cience **h**igh school Standard #**8**

Content Standards

S5P3
Science Grade **5** **P**hysical Science Standard #**3**

S4E2
Science Grade **4** **E**arth Science Standard #**2**

S7L4
Science Grade **7** **L**ife Science Standard #**4**

SC1
Science **C**hemistry Standard #**1**

SB4
Science **B**iology Standard #**4**

SPS6
Science **P**hysical **S**cience Standard #**6**

SP3
Science **P**hysics Standard #**3**

SAST2
Science **AST**ronomy Standard #**2**

SEC1
Science **EC**ology Standard #**1**

SEN3
Science **EN**tomology Standard #**3**

Entomology

The Entomology curriculum is designed to continue student investigations that began in grades K-8 and high school biology. To achieve the goal of entomological literacy these standards provide students with basic understanding of insect biology as it relates to agriculture, animal and human health, ecosystem functioning and monitoring, and insect products. Students will investigate these entomological concepts through laboratory and field experience using the processes of inquiry.

Major Concepts/Skills:	Concepts/Skills to Maintain:
Agriculture and Food Supply Animal Health Beneficial & Harmful Impact of Insects Evolution of Insects Coadaptation/coevolution Diversity & Classification of Insects Economic & Environmental Value of Insects Ecosystem Functioning Ecosystem Indicators Human Health Insect Products Morphological Structure and Function Risks & Benefits of Insect Control Life Cycle of Insects	Characteristics of Science Records investigations clearly and accurately Interprets graphs, tables, and charts Writes clearly Write formal Laboratory Reports Uses proper units Organizes data into graphs, tables, and charts Analyzes scientific data via calculations and inference Uses models Asks quality questions Design inquiry – based laboratory investigations 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.

a. Exhibit the above traits in their own scientific activities.
b. Recognize that different explanations often can be given for the same evidence.
c. 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.

a. Follow correct procedures for use of scientific apparatus.
b. Demonstrate appropriate technique in all laboratory situations.
c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.
b. Develop procedures for solving scientific problems.
c. 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

SEN1. Students will identify and analyze the roles of insects in ecosystems.

a. Illustrate the important function(s) of insects in diverse terrestrial and freshwater food webs (i.e., as herbivores, predators, and scavengers).
b. Explain the role of insects in various niches.
c. Compare species diversity and biomass in different terrestrial habitats and evaluate why insects are the dominant organisms worldwide by either measure.
d. Analyze the numerous ways that insects affect ecosystems (e.g., plant pollination, decomposers/recyclers of organic matter).
e. Discuss the importance of coevolution/coadaptation relationships between various insects and plants (e.g., how insects serve as pollen vectors of plants).
f. Explain how some groups of insects are used as water quality indicators because they are sensitive to habitat change.

SEN2. Students will investigate the reasons for insect success.

a. Investigate the insect body plan and compare and contrast to other arthropods (e.g., Arachnida, Crustacea).
b. Explain advantages of different insect life cycles (e.g., complete vs. incomplete).
c. Use morphological characteristics (e.g., wing structure) to recognize major insect orders.
d. Compare and contrast how insect structure and function are integrated and reflect evolved adaptations to different environments.

SEN3. Students will investigate the impact of insects on the production of food and other products.

a. Explain how humans use insect biology to make commercial products (e.g., silk, honey, lacquer, and dyes).
b. Evaluate the benefits of insects to ecosystem functioning for food production (e.g., pollinators of agricultural crops).
c. Evaluate the costs of insects as pests of crops, stored food, and housing (e.g., termites).
d. Analyze the economic impact that insects can have on livestock and pets (e.g., dog heartworm is transmitted by mosquitoes, and fleas are irritating pests).

SEN4. Students will investigate the impact of insects on human and animal health.

a. Relate the impact of insects that transmit serious diseases (e.g., malaria, yellow fever, plague, dengue fever, and West Nile virus) on public health.
b. Illustrate how insect-carried diseases have changed the course of human history (e.g., the Black Plague during the Middle Ages, and malaria in world history including Georgia).
c. Discuss how insects can affect human and animal health through allergic reactions (e.g., wasp stings, cockroach droppings, etc.).

SEN5. Students will evaluate methods for the management of insect populations for the benefit of humans.

a. Discuss the economic benefits of controlling insect population.
b. Explain how conventional spraying has caused the evolution of insect resistance, risks to human health and reduction of beneficial insect populations.
c. Explain how biological control of crop pests and undesirable plants is achieved through the use of beneficial insects (e.g., insect parasitoids, predators, and herbivores).
d. Evaluate the benefits and risks of using genetically modified crops to manage insect pests.
e. Discuss how Integrated Pest Management (IPM) limits evolution of insect resistance to chemical and other control means.
f. Research environmentally friendly ways in which humans can prevent or avoid many insect problems (e.g., repellents and traps).