Entomology Standards

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.

The Entomology Georgia Standards of Excellence are 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.

Entomology

SEN1. Obtain, evaluate, and communicate information about the roles of insects in ecosystems.

a. Construct an explanation for the role(s) of insects in diverse terrestrial and freshwater food webs (i.e., as herbivores, predators, and scavengers) and the need for conservation.
b. Ask questions to compare and contrast the prevalence of specific insect species in local Georgia regions.
c. Use mathematics and computational thinking to compare species diversity and biomass in different terrestrial habitats and evaluate why insects dominate both measures in most regions (e.g., field plot population sampling).
d. Construct an explanation of the importance of insects in ecosystem sustainability (e.g., plant pollination, decomposers/recyclers of organic matter).
e. Plan and carry out an investigation to demonstrate how some groups of insects are used as bio-indicators because they are sensitive or tolerant to habitat change conditions.
f. Construct an argument based on evidence to demonstrate co-evolution/co-adaptation relationships between various insects and plants (e.g. pollination syndrome).

SEN2. Obtain, evaluate, and communicate information about how insect morphology and adaptation is related to insect success.

a. Plan and carry out an investigation to compare and contrast the insect body plan to other arthropods (e.g., Chelicerates, Myriapods, and Crustaceans).
b. Construct arguments based on evidence to explain how different insect life cycles impact insect survival and success (e.g., complete vs. incomplete).
c. Develop and use a model to identify insects based on the morphological characteristics of the ten largest insect orders (e.g., Odonata, Lepidoptera, Homoptera, Hemiptera, Orthoptera, Coleoptera, Hymenoptera, Diptera, Blattodea, Siphonaptera).
(*Clarification statement:* This could include how some insects have evolved to control reproduction favoring female or "queen" survival.)
d. Analyze and interpret data on how insect structure and function are integrated and reflect evolved adaptations to different environments. (e.g., mimicry, camouflage.)
e. Ask questions and define problems related to the impact of non-native species on local ecosystems (e.g., the effect of bark beetles or wooly adelgids on local forests).

SEN3. Obtain, evaluate, and communicate information about the impact of insects on the production of food and other products and in popular culture and commerce.

a. Construct explanations of the contributions of insects to human culture and commerce (e.g., music, art, silk, honey, lacquer, and dyes).
b. Construct an argument based on evidence to demonstrate the importance of an insect's ecological niche in food production and food sources (e.g., pollinators of agricultural crops, human protein source, biomass pyramid).
c. Analyze and interpret data about the economic impact of insects as pests in agriculture, stored food, buildings, and domesticated animals (e.g., spotted-wing drosophila, sawtooth grain beetle, termites, fleas, flies).

SEN4. Obtain, evaluate, and communicate information about the impact of insects on human and other animal health, medicine, and biotechnology.

a. Develop and use a model to illustrate the impact of disease-transmitting insects (e.g., malaria, yellow fever, plague, dengue fever, and West Nile virus) on public health and human history (e.g., the Black Plague during the Middle Ages, and malaria in world history including Georgia).
(*Clarification statement:* Demonstrate that the spread of diseases is based on species survivability in certain habitats. e.g. – Zika doesn't currently move much higher than NC, TN because of the carrying species inability to survive in colder climates.)

b. Ask questions to investigate how insects can affect human and other animal health through allergic reactions (e.g., wasp stings, cockroach droppings).

c. Plan and carry out an investigation to demonstrate the application of forensic entomology and biotechnology in the area of crime scene analysis, insect toxins and pharmaceuticals, and neurological research.

SEN5. Obtain, evaluate, and communicate information about the relationship between human activity and insect populations.

a. Use mathematics and computational thinking to determine the significance of human behavior on insect populations (e.g., intended and unintended results of habitat destruction by human activity – pest control, industrialization, deforestation, global warming).

b. Ask questions to determine the impacts of controlling insect populations (e.g., intended and unintended results from pest management alternatives).

c. Construct an explanation based on evidence of how conventional pesticide application has impacted various ecological niches (e.g. insect resistance, human health, and beneficial insect populations).

d. Construct an argument based on evidence about the use of beneficial insects as a method of biological control of both agricultural crop and domesticated animal pests (e.g., insect parasitoids, predators, and herbivores).
(*Clarification statement:* Instruction should include both the biocontrol efforts that have worked as well as those that have failed or had unintended consequences (e.g., insect biocontrol agents preying on beneficial insects instead of the target insect)).

e. Plan and carry out an investigation of the benefits and risks of using genetically modified crops to manage insect pests.

f. Design an environmentally friendly solution to pest control (e.g., repellents and traps).

g. Design a plan using Integrated Pest Management (IPM) to limit insect resistance to control strategies, while encouraging pollinator protection.