Science Georgia Standards of Excellence

SCIENCE - Botany

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 standards presented in this document are created to guide the teacher through a course in botany that allows the student to feel confident at an introductory level for this field. These standards are meant to motivate students toward a genuine interest in botany and its related fields with possible job interests for the future. The skills a student masters through this coursework should help to prepare them for a related occupation, demonstrate proficiency in a college course of the same nature, and enrich their skill level for any additional science courses. Students should gain an ability to notice plants in their own environment, recognize the importance of plants to the planet and in human affairs, as well as appreciate the unique biological features of plants.

SBO1. Obtain, evaluate, and communicate information to analyze the nature of the relationships between plant morphological structures and anatomical structures, functions, and processes.

a. Ask questions to investigate and provide explanations about the basic plant structures (i.e., major organs, tissues, and cells) in relation to their functions.
(*Clarification statement:* Instruction for plant structures and functions should address how plastic or rigid these can be in plants.)

b. Construct an explanation supported by evidence relating plant structures to plant processes (photosynthesis, respiration, transport, growth, reproduction, and dispersal).
(*Clarification statement:* Instruction should focus on understanding major processes such as light and dark reactions of photosynthesis, Glycolysis, Krebs Cycle, Electron Transport Chain, upward movement of water and nutrients (ascent of sap), movement of food, growth forms, vegetative and sexual reproduction, seed dispersal mechanisms, and how morphological and anatomical structures support these processes.)

c. Develop and use a model to trace the origin of changes of major plant structures and organs through geological time, in response to major changes in the environment (i.e., development of vascular tissues, change from spores to seed formers).

d. Construct an explanation about the coevolution of plant morphological and anatomical structures with animals (i.e., pollination), *Rhizobium* (i.e., nitrogen fixation), and Mycorrhiza (i.e., fungi in rhizosphere).
(*Clarification statement*: In addressing pollination, be aware that students may have a misconception that insects are the sole source of pollination. Vertebrates, wind, fire and water also play a part. While not all are examples of coevolution, they represent reproductive/dispersal strategies and advancements by some plant groups.)

e. Use mathematical models to predict the effect of hormones on structural growth of a plant in response to an external stimulus. (Focus on phototropism, geotropism, and thigmotropism).

SBO2. Obtain, evaluate, and communicate information to delineate the plant divisions based on current plant phylogenetic and taxonomic principles.

a. Construct an explanation based on evidence to compare nonvascular to vascular plants and seedless to seed plants.

b. Construct an argument based on evidence from traditional methods and emerging technologies (i.e., using physical characteristics and molecular evidences) to classify plants into major plant divisions.

c. Analyze and interpret data to develop models (i.e., cladograms and phylogenetic trees) based on patterns of common ancestry or convergence.

SBO3. Obtain, evaluate, and communicate information to describe Georgia's major physiographic ecoregions, their representative natural plant communities, and their conservation.

a. Analyze and interpret data using taxonomic keys to identify and compare the major plant forms that dominate natural plant communities growing in aquatic and terrestrial habitats and the ecosystems they support in Georgia.
b. Construct an argument based on evidence of the impact of non-native invasive plants on Georgia's natural communities.
c. Construct explanations of the factors that cause plants to become endangered and design solutions to prevent extinction.
d. Design a solution to create sustainable plant communities within Georgia's ecoregions and reduce negative human impact.
(*Clarification statement:* Solutions to creating sustainable plant communities include, but are not limited to, restoration and reintroduction science, propagation methods, and habitat management.)

SBO4. Obtain, evaluate, and communicate information to analyze the impact of plant diseases and pests on plant defense systems and agriculture.

a. Ask questions based on observational, investigative or research evidence to develop sustainable management strategies for common plant diseases.
(*Clarification statement:* Management strategies and practices could focus on agricultural and landscaping plants.)
b. Construct an explanation based on research (i.e., case studies) to evaluate how plant diseases affect humans, animals, and the economy.
c. Plan and carry out an investigation to determine how plants respond to insect pests and pathogens, and note the plant defense mechanism.
(*Clarification statement:* Instruction should include diseases caused by common bacteria, viruses, fungi and vectored by insects.)

SBO5. Obtain, evaluate, and communicate information to analyze the diversity of plant adaptations and responses to changing environmental conditions.

a. Construct an explanation to describe the diversity of plants and their adaptations in relation to differing ecosystems and changing environments, both long term (climate) and short term (seasonal and diurnal).
(*Clarification statement:* Instruction should focus on climatic, seasonal, and diurnal changes.)
b. Construct an argument based on evidence to predict which plant adaptions increase survival in different stressful environments (i.e., water extremes, saline environment, and extreme temperature).
c. Develop and use models to analyze how change and disruptions in major nutrient cycles (i.e., C, H, O, N, P) might affect plant responses.

SBO6. Obtain, evaluate, and communicate information to analyze the economic and ecological importance of plants in human society.

a. Construct an explanation of how plants are used in different societies (agriculture, horticulture, industry, medicine, biotechnology).
b. Develop a model to explain how plants impact the environment by providing diverse habitats for birds, insects, and other wildlife in ecosystems.
(*Clarification statement*: Include urban environments and how plants mitigate flooding and heat island effects and create cleaner air and water.)
c. Construct an argument based on evidence to explain the use and potential benefits of genetically modified plants through traditional and modern molecular techniques and investigate the bio-ethical issues related to genetic engineering of plants.