Science Georgia Standards of Excellence

SCIENCE - Geology

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 geology course is designed to lead the student toward a successful understanding of introductory geologic science. The goal of this course is to provide students with a basic understanding of geology, geologic processes, and how geology impacts our society. The curriculum investigates the Earth's formation, Earth materials and processes, available and important resources, changing landscapes and climate, catastrophic events, and society's attempt to deal with our ever-changing world. Students can make real-world connections by examining our role in the solar system, man's effect upon our mineral and rock resources, seismic events, landforms and how a changing climate has the ability to alter life as we know it, thus applying their knowledge to these real-world situations.

SG1. Obtain, evaluate, and communicate information to understand the formation of Earth and the evolution of its component systems.

a. Construct an explanation based on evidence for the formation of the Earth.
(*Clarification statement*: The mechanisms of accretion and differentiation should be addressed here. Include an understanding of Earth's elemental composition, the Nebular Theory and the Iron Catastrophe Theory.)

b. Develop a model of the Earth's internal structures including both physical (i.e., lithosphere, asthenosphere, mesosphere, outer core and inner core) and chemical (crust, mantle, core) layers.
(*Clarification statement:* Include how data, computer technology, and computational thinking are used to determine thicknesses and chemical composition of the layers.)

c. Construct an explanation based on evidence for the origin and evolution of Earth's hydrosphere and atmosphere.
(*Clarification statement:* Include the ideas of outgassing, photochemical dissociation, photosynthesis and comet delivery.)

SG2. Obtain, evaluate, and communicate information about the geologic conditions and processes that form different rocks and minerals through the rock cycle.

a. Plan and carry out investigations to explore how chemical variation and geological processes result in the formation of different rock forming minerals.
(*Clarification statement:* This could include the formation of quartz, K-feldspar, plagioclase, muscovite, biotite, amphibole, pyroxene, olivine, kaolinite, calcite, halite, gypsum, chlorite, garnet and staurolite.)

b. Develop and use models to demonstrate the processes that form plutonic (intrusive) and volcanic (extrusive) igneous rocks of differing compositions, and textures.

c. Ask questions to differentiate between processes that form various types of sedimentary rocks (i.e., weathering, erosion, deposition, burial, compaction and cementation).

d. Construct an explanation for how igneous and sedimentary rocks transform to different types of metamorphic rocks.
(*Clarification statement:* Explain how different conditions of metamorphism and starting (parent) rock compositions determine metamorphic rock type.)

SG3. Obtain, evaluate, and communicate information to explore geologic time.

a. Analyze data to interpret sequences of events in Earth's history.
(*Clarification statement:* Include relative vs. absolute dating techniques, principles of stratigraphy (e.g. Superposition and cross-cutting relationships), radiometric dating, and the fossil record.*)*

b. Construct an argument based on evidence about how catastrophic and long-term events have impacted the evolution of life on Earth, including mass extinctions (e.g., asteroid/comet impact, plate tectonics and climate change).

c. Obtain, evaluate, and communicate information that documents important tectonic events and sea level/climatic changes in Georgia over geologic time.
(*Clarification statement:* Include a description and origin of the Valley and Ridge, Piedmont, Blue Ridge Mountains, and the Coastal Plain physiographic provinces.)

SG4. Obtain, evaluate, and communicate information about the evidence for plate tectonics; investigate the roles of Earth's internal processes as a mechanism of plate motion; and assess the relationship between plate tectonic boundary type and geologic hazards.

a. Construct an explanation based on evidence that describes the mechanisms causing tectonic plate movement, the different types of plate boundaries, and how boundary type relates to mountain building, earthquakes, volcanism, and features such as volcanic arcs, hot spots, and mid ocean ridges.
(*Clarification statement:* Include the role of radioactive decay as a source of heat energy driving the process of convection, as well as the physical processes of slab pull and ridge push.)

b. Construct an explanation based on evidence that describes the mechanisms that create melt in the lithosphere in relationship to plate tectonics.
(*Clarification statement:* The role of pressure release, added heat, and added water content should be studied relative to the plate tectonic locations where this melting occurs.)

c. Use models to predict and differentiate between the various types of folds and faults.
(*Clarification statement*: Show the relationship between stress and strain relative to nature and type of deformation.)

d. Use models to communicate the differences between folded, fault-block, dome, plateau**,** and volcanic mountains to investigate their relationship to tectonic setting.

e. Analyze and interpret data to classify volcanoes using their interior/exterior features, magma composition, lithology, and plate tectonic setting

f. Analyze and interpret seismic data and assess risk of volcanic eruptions and earthquakes in Georgia and other areas in the United States.
(*Clarification statement:* Include sources of seismic risk in Georgia from historic tectonic events (stored energy at "dormant" fault zones).)

SG5. Obtain, evaluate, and communicate information to explain the effects of Earth's surface processes.

a. Ask questions to understand the effects of regional climate on weathering processes and soil formation.

b. Construct an argument from evidence to explain how sedimentary rock formation and chemical weathering changes greenhouse gas concentrations in Earth's atmosphere.

c. Obtain, evaluate, and communicate information to characterize the formation of landforms in desert and glacial environments.
(*Clarification statement:* Information sources should include, geologic maps, topographic maps, cross-sectional maps, and remote sensing data.)

d. Develop and use models to examine the erosional and depositional features of various coastal systems.

e. Plan and carry out an investigation to analyze how surface water and groundwater act as major agents of change in fluvial systems.
(*Clarification statement*: Include surface reservoirs, groundwater reservoirs, and fluvial systems, as well as the processes of infiltration, runoff, evaporation, and precipitation.)

SG6. Obtain, evaluate, and communicate information to investigate the distribution, extraction, and use of resources on the Earth and other bodies in the Solar System.

a. Ask questions to investigate the origin, distribution, and economic importance of geologic resources, including those mined in Georgia.
(*Clarification statement:* Include kaolin, marble, gold, dimension stone and crushed stone aggregate, sand and gravel as major parts of the state economy.)

b. Construct an argument from evidence to support a claim about the impact of extraction and use of geological resources in the environment and human life.
(*Clarification statement*: Impact of climate change, drilling for oil, mining and fracking should be discussed here.)

c. Analyze and interpret data to predict and develop evidence for the occurrence and distribution of geologic resources on the Moon, other planets, and extraterrestrial bodies (asteroids, meteors, and comets).