Georgia Standards of Excellence and Summer Earth Studies

GSE Standards: Earth Systems	Summer Earth Studies (SES)
Excerpts from Recommended Pedagogy: 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. At the same time, these standards set a maximum expectation on what will be assessed by the Georgia Milestones Assessment System. 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 Earth Systems Georgia Standards of Excellence are designed to continue student investigations that began in K-8 Earth Science and Life Science curricula on the connections among Earth's systems through Earth history. These systems – the atmosphere, hydrosphere, geosphere, and biosphere – interact through time to produce the Earth's landscapes, ecology, and resources. These standards engage the students in constructing explanations of phenomena fundamental to the sciences of geology and physical geography, including the early history of the Earth, plate tectonics, landform evolution, the Earth's geologic record, weather and climate, and the history of life on Earth. Instruction should focus on development of scientific explanations, rather than mere descriptions of phenomena. Case studies, laboratory exercises, maps, and data analysis should be integrated into units. Special attention should be paid to topics of current interest (e.g., recent earthquakes, tsunamis, global warming, price of resources) and to potential careers in the geosciences.	**SES is an experiential field course that covers the earth systems standards. It is designed to challenge honors-level rising 11th and 12th grade students. It also serves as a capstone course that merges physics, chemistry, and biology concepts in the analysis of earth systems. The course has over 120 contact hours, or an average 5.5 hours per day over 23 days. The course is entirely hands-on, student-centered, problem-based learning. Student teams solve 15-20 case study problems where much of their data is gathered from first-hand observations made on location. Students maintain a field notebook where they collect qualitative and quantitative data, apply formulas, make graphs, and draw topographic, geologic, and weather maps, and construct hypotheses. The course spends 5 days exploring the physiographic provinces of Georgia and the formation of the Appalachian Mountains and 18 days exploring the Rocky Mountains, the Basin and Range, Snake River Plains, Yellowstone Hot Spot, intermontane basins, and the Colorado Plateau.** **Cartography** **A. Orientation** **1. Grid system** **2. Reference point** **B. Types of maps** **C. Highway maps** **D. Latitude, longitude, magnetic declination** **E. Compass and its use** **1. Magnetic field** **2. Triangulation** **F. Topographic maps**
SES1. Obtain, evaluate, and communicate information to investigate the composition and formation of Earth systems, including the Earth's place in the solar system. 1. Construct an explanation of the origins of the solar system from scientific evidence including the composition, distribution and motion of solar system objects. 2. Ask questions to evaluate evidence for the development and composition of Earth's early systems, including the geosphere (crust, mantle and core), hydrosphere and atmosphere. 3. Develop a model of the physical composition of Earth's layers using	**Astronomy** **A. Earth in space – structure, formation** **B. Earth, moon, sun relationships** **C. Observation and measurement in space** **D. Solar system** **1. Sun** **2. Inner planets** **3. Outer planets** **4. Moons, asteroids, meteors, meteorite impacts**

multiple types of evidence.	**E. Beyond the solar system** **1. Red shift / Big bang** **2. Stellar evolution** **3. Galaxies and constellations** **4. Quasars, pulsars, black holes**
SES2. Obtain, evaluate, and communicate information to understand how plate tectonics creates certain geologic features, landforms, Earth materials, and geologic hazards. 1. Construct an explanation based on evidence that describes the mechanisms causing plate tectonic motion. 2. Develop and use models for the different types of plate tectonic settings (convergent, divergent and transform boundaries). 3. Construct an explanation that communicates the relationship of geologic features, landforms, Earth materials and geologic hazards to each plate tectonic setting. 4. Ask questions to compare and contrast the relationship between transformation processes of all rock types (sedimentary, igneous, and metamorphic) and specific plate tectonic settings. 5. Construct an argument using multiple forms of evidence that supports the theory of plate tectonics.	**Physical Geology** **A. Earth Composition** **1. Rocks** **2. Minerals** **3. Rock cycle** **B. Earth processes** **1. Weathering** **2. Erosion – moving water, gravity, wind, glaciation** **3. Sedimentation** **4. Stratigraphy** **5. Caves and cave formation** **C. Depositional environments** **D. Earth stresses and structure** **1. Tension, compression, shear** **2. Folding** **3. Fracture / joints** **4. Faults** **5. Earthquakes** **6. Volcanoes** **E. Plate tectonics** **1. Types of plate boundaries and surface patterns** **2. Plate boundary interactions and crustal stresses** **3. Passive boundaries, subsidence, sedimentary basins** **4. Rock types and rock cycle** **5. Mantle convection** **6. Hot spots** **7. Exotic terranes** **F. Natural resources** **1. Mining – ores, importance, formation, environmental impact** **2. Fossil fuels – types, importance, exploration and production, environmental impact**
SES3. Obtain, evaluate, and communicate information to explore the actions of water, wind, ice, and gravity as they relate to landscape change. 1. Plan and carry out an investigation that demonstrates how surface water and groundwater act as the major agents of physical and chemical weathering. 2. Develop a model of the processes and geologic hazards that result from both sudden and gradual mass wasting. 3. Construct an explanation that relates the past and present actions of ice, wind, and water to landform distribution and landscape change. 4. Construct an argument based on evidence that relates the characteristics of the sedimentary materials to the energy by which they were transported and deposited.	
SES4. Obtain, evaluate, and communicate information to understand how rock relationships and fossils are used to reconstruct the Earth's past. 1. Use mathematics and computational thinking to calculate the absolute age of rocks using a variety of methods. 2. Construct an argument applying principles of relative age (superposition, original horizontality, cross-cutting relations, and original lateral continuity) to interpret a geologic cross-section and describe how unconformities form. 3. Analyze and interpret data from rock and fossil succession in a rock sequence to interpret major events in Earth's history such as mass extinction, major climatic change, and tectonic events. 4. Construct an explanation applying the principle of uniformitarianism	**Historical Geology** **A. Geologic Time Scale** **B. Absolute age dating** **C. Relative age dating** **D. Biological evolution / fossils** **E. North American geologic events – Appalachian and Rocky Mountain formation** **F. Ice Ages**

to show the relationship between sedimentary rocks and their fossils to the environments in which they were formed. 5. Construct an argument using spatial representations of Earth data that interprets major transitions in Earth's history from the fossil and rock record of geologically defined areas.	
SES5. Obtain, evaluate, and communicate information to investigate the interaction of solar energy and Earth's systems to produce weather and climate. 1. Develop and use models to explain how latitudinal variations in solar heating create differences in air pressure, global wind patterns, and ocean currents that redistribute heat globally. 2. Analyze and interpret data. 3. Construct an argument that predicts weather patterns based on interactions among ocean currents, air masses, and topography. 4. Analyze and interpret data to show how temperature and precipitation produce the pattern of climate regions (zones) on Earth. 5. Construct an explanation that describes the conditions that generate extreme weather events (e.g., hurricanes, tornadoes, and thunderstorms) and the hazards associated with these events. 6. Construct an argument relating changes in global climate to variation to Earth/sun relationships and atmospheric composition.	**Meteorology** **A. Weather's "ingredients" and their properties (water, air, ground, solar heating)** **B. Wind – global, Coriolis effect, jet streams** **C. Water in the atmosphere** **D. Air masses, fronts, pressure areas, weather maps** **E. Severe weather - thunderstorms, tornadoes, hurricanes** **F. Climate** **G. Climate change**
SES6. Obtain, evaluate, and communicate information about how life on Earth responds to and shapes Earth's systems. 1. Construct an argument from evidence that describes how life has responded to major events in Earth's history (e.g., major climatic change, tectonic events) through extinction, migration, and/or adaptation. 2. Construct an explanation that describes how biological processes have caused major changes in Earth's systems through geologic time. 3. Ask questions to investigate and communicate how humans depend on Earth's land and water resources, which are distributed unevenly around the planet as a result of past geological and environmental processes. 4. Analyze and interpret data that relates changes in global climate to natural and anthropogenic modification of Earth's atmosphere and oceans.	**Historical Geology** **A. Geologic Time Scale** **B. Absolute age dating** **C. Relative age dating** **D. Biological evolution / fossils** **E. North American events** **Life Science** **A. Classification** **B. Ecology** **1. Ecosystems** **2. Organisms** **3. Populations** **4. Species interactions** **5. Communities** **6. Ecological succession** **C. Field identification** **D. Human impact**