

Tennessee Science Curriculum Framework

Geology

Course Description

Geology is a laboratory course that explores the origins and the connections among the physical, chemical, and biological processes of the earth system. Students explore the physical aspects of earth processes and cycles through *inquiry-based field and laboratory investigations*.

Understanding the importance of these processes and how they influence humankind enables students to make sound decisions about their community and the earth's global environment.

Geology students investigate:

- Inquiry
- Technology and Engineering
- Maps
- Matter and Minerals
- The Rock Cycle
- Geologic History
- Plate Tectonics
- Landforms

Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Course Level Expectations

CLE 3205.Inq.1 Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

CLE 3205.Inq.2 Design and conduct scientific investigations to explore new phenomena, verify previous results, test how well a theory predicts, and compare opposing theories.

CLE 3205.Inq.3 Use appropriate tools and technology to collect precise and accurate data.

CLE 3205.Inq.4 Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias.

CLE 3205.Inq.5 Compare experimental evidence and conclusions with those drawn by others about the same testable question.

CLE 3205.Inq.6 Communicate and defend scientific findings.

Checks for Understanding (Formative/Summative Assessment)

- ✓ **3205.Inq.1** Trace the historical development of a scientific principle or theory, such as plate tectonics, evolution of landforms, and global climate change.
- ✓ **3205.Inq.2** Conduct scientific investigations that include testable questions, verifiable hypotheses, and appropriate variables to explore new phenomena or verify the experimental results of others.
- ✓ **3205.Inq.3** Select appropriate tools and technology to collect precise and accurate quantitative and qualitative data.
- ✓ **3205.Inq.4** Determine if data supports or contradicts a hypothesis or conclusion.
- ✓ **3205.Inq.5** Compare or combine experimental evidence from two or more investigations.
- ✓ **3205.Inq.6** Recognize, analyze, and evaluate alternative explanations for the same set of observations.
- ✓ **3205.Inq.7** Evaluate the accuracy and precision of data.
- ✓ **3205.Inq.8** Analyze experimental results and identify possible sources of bias or experimental error.
- ✓ **3205.Inq.9** Formulate and revise scientific explanations and models using logic and evidence.

Embedded Technology and Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

How do science concepts, engineering skills, and applications of technology improve the quality of life?

Course Level Expectations

- CLE 3205.T/E.1** Explore the impact of technology on social, political, and economic systems.
- CLE 3205.T/E.2** Differentiate among elements of the engineering design cycle: design constraints, model building, testing, evaluating, modifying, and retesting.
- CLE 3205.T/E.3** Explain the relationship between the properties of a material and the use of the material in the application of a technology.
- CLE 3205.T/E.4** Describe the dynamic interplay among science, technology, and engineering within living, earth-space, and physical systems.

Checks for Understanding (Formative/Summative Assessment)

- ✓3205.T/E.1 Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.
- ✓3205.T/E.2 Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.
- ✓3205.T/E.3 Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.
- ✓3205.T/E.4 Explore how the unintended consequences of new technologies can impact human and non-human communities.
- ✓3205.T/E.5 Evaluate the overall benefit to cost ratio of a new technology.
- ✓3205.T/E.6 Present research on current bioengineering technologies that advance health and contribute to improvements in our daily lives.
- ✓3205.T/E.7 Design a series of multi-view drawings that can be used by other students to construct an adaptive design and test its effectiveness.

Standard 1 - Maps

Conceptual Strand

Maps represent earth's landforms and provide tools for studying geologic processes.

Guiding Question

What geologic features are represented on maps and how can maps provide clues that explain geologic processes?

Course Level Expectations

- CLE 3205.1.1 Read and interpret topographic and geologic maps.
- CLE 3205.1.2 Use geologic maps to investigate rock types, time periods, and faults and folds.
- CLE 3205.1.3 Investigate technologies used to create maps.
- CLE 3205.1.4 Apply maps for planning purposes and to investigate land-use problems.

Checks for Understanding (Formative/Summative Assessment)

- ✓3205.1.1 Identify basic map symbols and legends.
- ✓3205.1.2 Differentiate between longitude and latitude.
- ✓3205.1.3 Determine the latitude and longitude of specific map points.
- ✓3205.1.4 Investigate the concept of map scale.
- ✓3205.1.5 Determine scaled map distances.
- ✓3205.1.6 Explain the concept of elevation.
- ✓3205.1.7 Determine the elevations of specific points on a topographic map.
- ✓3205.1.8 Construct a 3-D representation of a topographical map that illustrates contour lines.
- ✓3205.1.9 Construct an elevation profile from topographic map data
- ✓3205.1.10. Identify landforms and determine stream flow direction using a topographic map.
- ✓3205.1.11 Use field data to create a topographic map of a landform

- ✓3205.1.12 Interpret basic rock types, time periods, and faults from geologic maps.
- ✓3205.1.13 Determine compass readings at selected sites.
- ✓3205.1.14 Investigate methods of remote sensing used to measure and monitor the earth's crust.
- ✓3205.1.15 Use a GPS unit to identify latitude, longitude, and elevation of a location.

Standard 2 - Matter and Minerals

Conceptual Strand

Minerals are naturally occurring substances formed through geological processes that have characteristic physical and chemical properties.

Guiding Question

How do minerals form and what are their unique characteristics?

Course Level Expectations

- CLE 3205.2.1** Describe how atoms serve as building blocks for all matter.
- CLE 3205.2.2** Apply the periodic table to determine the properties of an element.
- CLE 3205.2.3** Describe the geologic processes that result in mineral formation.
- CLE 3205.2.4** Distinguish between the physical and chemical properties of minerals.
- CLE 3205.2.5** Investigate the structure and geometry of crystals.

Checks for Understanding (Formative/Summative Assessment)

- ✓3205.2.1 Create a model of an atom based on information found in the periodic table.
- ✓3205.2.2 Classify a substance as an element or a compound.
- ✓3205.2.3 Interpret the periodic table to identify groups of elements as reactive or non-reactive metals, nonmetals, or gases.
- ✓3205.2.4 Explore the physical and chemical properties of minerals.
- ✓3205.2.5 Identify mineral samples using simple physical property tests and a mineral identification table.
- ✓3205.2.6 Recognize that water is a major solvent that releases elements and minerals from earth materials.
- ✓3205.2.7 Describe the crystal structure of minerals in terms of atomic size, method of bonding, and the environment.
- ✓3205.2.8 Construct models of the six major crystal systems.
- ✓3205.2.9 Classify minerals such as silicates, native elements, carbonate, and sulfates according to their chemical formulas.
- ✓3205.2.10 Create a presentation for a mineral that includes its physical properties, an illustration, mining technique, occurrence, and use.
- ✓3205.2.11 Explore gems and their importance to man.
- ✓3205.2.12 Create a brochure on the mineral resources of Tennessee.

Standard 3 - The Rock Cycle

Conceptual Strand

The rock cycle explains how different rock types are related to each other and how earth processes transform rocks from one type to another over geologic time.

Guiding Question

How does the rock cycle explain the origin of different rock types?

Course Level Expectations

CLE 3205.3.1 Identify and differentiate among the three rock groups.

CLE 3205.3.2 Describe the processes responsible for forming the three rock groups.

CLE 3205.3.3 Examine the characteristics of each rock group.

CLE 3205.3.4 Explain the rock cycle.

Checks for Understanding (Formative/Summative Assessment)

✓**3205.3.1** Distinguish among sedimentary, igneous, and metamorphic rocks.

✓**3205.3.2** Diagram the rock cycle including the processes involved in the formation of each rock group.

✓**3205.3.3** Recognize that rocks are composed of various combinations of minerals.

✓**3205.3.4** Distinguish between intrusive (plutonic) and extrusive (volcanic) igneous rocks.

✓**3205.3.5** Differentiate among plutonic bodies such as sills, dikes, batholiths, and laccoliths.

✓**3205.3.6** Identify the properties of igneous rocks such as granite, rhyolite, basalt, gabbro, obsidian, and pumice.

✓**3205.3.7** Understand sedimentary processes.

✓**3205.3.8** Distinguish between clastic, chemical, and biogenic textures and processes forming each.

✓**3205.3.9** Identify sedimentary rock features such as stratification, fossils, graded bedding, ripple marks, and mudcracks.

✓**3205.3.10** Identify the properties of sedimentary rocks such as sandstone, shale, limestone, coquina, coal, and conglomerate.

✓**3205.3.11** Differentiate between foliated and non-foliated metamorphic rocks.

✓**3205.3.12** Compare and contrast regional and contact metamorphism.

✓**3205.3.13** Identify the properties of metamorphic rocks such as gneiss, marble, schist, slate, and quartzite.

✓**3205.3.14** Interpret Bowen's reaction series.

✓**3205.3.15** Describe gradational metamorphism based on index minerals and metamorphic rock types.

Standard 4 - Geologic History

Conceptual Strand

The earth has changed over a long period and global change is a continuation of that evolutionary process.

Guiding Question

What is the scientific evidence for the evolution of earth and life on earth?

Course Level Expectations

- CLE 3205.4.1** Interpret the nature of geologic time.
- CLE 3205.4.2** Investigate the evolution of earth.
- CLE 3205.4.3** Investigate the history of life.
- CLE 3205.4.4** Interpret the fossil record for evidence of biological evolution.
- CLE 3205.4.5** Demonstrate the impact of environmental change on the origin and extinction of plant and animal species.
- CLE 3205.4.6** Investigate the long-term aspects of global change and explain how these events have influenced current global patterns.

Checks for Understanding (Formative/Summative Assessment)

- ✓**3205.4.1** Describe how scientists estimate the age of the earth.
- ✓**3205.4.2** Compare and contrast how relative and absolute dating techniques are used to interpret geologic history.
- ✓**3205.4.3** Construct a geologic timetable that illustrates the evolution of earth and the history of life.
- ✓**3205.4.4** Explain the law of uniformitarianism.
- ✓**3205.4.5** Recognize that fossils are found in sedimentary rock.
- ✓**3205.4.6** Compare and contrast fossil forms of life with modern organisms.
- ✓**3205.4.7** Recognize that fossils provide evidence of past life forms, changes in life forms, and past environmental conditions.
- ✓**3205.4.8** Examine the fossil record to describe the environmental adaptations in a group of organisms.
- ✓**3205.4.9** Describe the evidence for plate tectonics such as fossil record, mountain ranges, rock strata, paleomagnetism, paleoclimates, and the configuration of continents.
- ✓**3205.4.10** Determine the relative age of fossils in sedimentary rock.
- ✓**3205.4.11** Interpret the sequence of rock strata using superposition, cross-cutting relationships, inclusions, the fossil record, and absolute data techniques.
- ✓**3205.4.12** Predict how an environmental change will affect the development of new species or the extinction of an existing species.
- ✓**3205.4.13** Make a timeline of global change through geologic time such as sea level change, climate change, paleogeographic change, and biotas.

Standard 5 - Plate Tectonics

Conceptual Strand

Plate tectonics is the grand unifying theory of geology.

Guiding Question

How does the theory of plate tectonics connect all geologic processes and explain major geologic phenomena?

Course Level Expectations

CLE 3205.5.1 Describe the major evidence to explain the theory of plate tectonics.

CLE 3205.5.2 Recognize different types of plate boundaries.

CLE 3205.5.3 Explain how convection currents provide the driving mechanism for plate movement.

CLE 3205.5.4 Describe processes associated with volcanoes, earthquakes, and mountain building.

Checks for Understanding (Formative/Summative Assessment)

✓**3205.5.1** Identify plate boundaries on a diagram.

✓**3205.5.2** Match continent boundary shapes to provide evidence of continental drift.

✓**3205.5.3** Identify the earth's layers.

✓**3205.5.4** Identify geologic features associated with divergent, convergent, and transform plate boundaries.

✓**3205.5.5** Identify the evidence for plate tectonics such as paleomagnetism, fossil record, continental boundaries, and hot spots.

✓**3205.5.6** Describe how convection currents drive plate movement.

✓**3205.5.7** Investigate the relationships among volcanoes, earthquake activity, and plate boundaries.

✓**3205.5.8** Distinguish among reverse, normal, and strike-slip faults.

✓**3205.5.9** Distinguish between an anticline and a syncline.

✓**3205.5.10** Correlate plate movement by plotting the movement of plates over hot spots.

Standard 6 - Landforms

Conceptual Strand

Geologic processes sculpt the earth into landforms characterized by differences in topography.

Guiding Question

How do earth's interacting systems produce a variety of landforms?

Course Level Expectations

CLE 3205.6.1 Investigate the hydrosphere and how changes in the hydrosphere affect various landforms.

CLE 3205.6.2 Associate the surface processes responsible for various landforms.

CLE 3205.6.3 Describe the characteristics of groundwater and explain how human activities affect groundwater quality.

Checks for Understanding (Formative/Summative Assessment)

- ✓**3205.6.1** Recognize that the earth's landforms change over time.
- ✓**3205.6.2** Illustrate the hydrologic cycle and distinguish among condensation, evaporation, precipitation, transpiration, groundwater, runoff, and surface water reservoirs.
- ✓**3205.6.3** Compare the impact of water, wind, ice, and living things as agents of geologic change.
- ✓**3205.6.4** Describe landforms associated with deserts, glaciers, shorelines, and rivers.
- ✓**3205.6.5** Describe groundwater and its characteristics.
- ✓**3205.6.6** Illustrate stream discharge using the Tennessee River or a local stream system.
- ✓**3205.6.7** Describe the fluvial processes of erosion and deposition
- ✓**3205.6.8** Describe the characteristics of a river in terms of its velocity, channel shape, depth, and discharge.
- ✓**3205.6.9** Identify meanders, point bars, cut banks, and cutoffs on a map.
- ✓**3205.6.10** Explain the processes of grain suspension, saltation, and settling to produce sedimentary deposits.
- ✓**3205.6.11** Describe a floodplain and demonstrate how stream channels and natural levees function during flood conditions.
- ✓**3205.6.12** Describe delta formation.
- ✓**3205.6.13** Investigate the influence of landforms on man's cultural, social, and economic development.