





Earth Systems Standards

The Cobb Teaching and Learning Standards (CT & LS) for Science 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 Cobb Teaching and Learning Standards 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 Cobb Teaching and Learning Standards drive instruction for science. 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 Cobb Teaching and Learning Standards for Earth Systems 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.

Unit 1	Unit 2	Unit 3	Unit 4	Unit 5:	Unit 6:	Unit 7:	Unit 8:
1 wk BL/2	2 wks BL/4 wks YR	4 wks BL/8 wks YR	2 wks BL/4 wks	1.5 wks BL/3	3 wks BL/6 wks YR	3 wks BL/6wks YR	1.5 wks BL/3 wks
wks YR			YR	wks YR			YR
	Lature durations to Fouth?	Atus sauk sus sud			Dista Tastania, Fasthanalas		
Intro to	Introduction to Earth's	Atmosphere and	Landscape	Minerals, Rocks,	Plate Tectonics, Earthquakes,	Geologic Time	How Life Shapes the
Systems and	Beginnings SE1	Meteorology SES5	Changes	and the Rock	and Landforms SES2, SES3	SES4	Earth SES6
Maps SES1			SES3	Cycle SES2, SES3			
SES1 Obtain,	SES1. Obtain, evaluate, and	SES5. Obtain, evaluate, and	SES3. Obtain,	SES2. Obtain,	SES2. Obtain, evaluate, and	SES4. Obtain, evaluate, and	SES6. Obtain, evaluate,
evaluate, and	communicate information to	communicate information to	evaluate, and	evaluate, and	communicate information to	communicate information	and communicate
communicate	investigate the composition	investigate the interaction of	communicate	communicate	understand how plate tectonics	to understand how rock	information about how
information	and formation of Earth	solar energy and Earth's	information to	information to	creates certain geologic features,	relationships and fossils are	life on Earth responds
to investigate	systems, including the	systems to produce weather	explore the	understand how	landforms, Earth materials, and	used to reconstruct the Earth's past.	to and shapes Earth's systems.
the	Earth's place in the solar	and climate.	actions of water,	plate tectonics	geologic hazards.	a. Use mathematics and	a. Construct an
composition	system.	a. Develop and use models to	wind, ice, and	creates certain	a. Construct an explanation based	computational thinking to	argument from
and	a. Construct an explanation	explain how latitudinal	gravity as they	geologic features,	on evidence that describes the	calculate the absolute age of	evidence that describes
formation of	of the origins of the solar	variations in solar heating create	relate to	landforms, Earth	mechanisms causing plate	rocks using a variety of	how life has responded
Earth	system from scientific	differences in air pressure,	landscape change.	materials, and	tectonic motion.	methods (e.g., radiometric	to major events in
systems,	evidence including the	global wind patterns, and ocean	a. Plan and carry	geologic hazards.	b. Develop and use models for	dating, rates of erosion,	Earth's history (e.g.,
including the Earth's place	composition, distribution and	currents that redistribute heat	out an	d. Ask questions to compare and	the different types of plate	rates of deposition, and varve count).	major climatic change, tectonic events)
in the solar	motion of solar system	globally.	investigation that	contrast the	tectonic settings (convergent,	b. Construct an argument	through extinction,
system.	objects. (Clarification	b. Analyze and interpret data	demonstrates how	relationship	divergent and transform	applying principles of	migration, and/or
.,	statement: The nebular	(e.g., maps, meteograms, and	surface water and	between	boundaries).	relative age (superposition,	adaptation.
b. Ask	hypothesis should be	weather apps) that demonstrate	groundwater act	transformation	c. Construct an explanation that	original horizontality, cross-	b. Construct an
questions to	included in this element.)	how the interaction and	as the major	processes of all	communicates the relationship of	cutting relations, and	explanation that
evaluate	b. Ask questions to evaluate	movement of air masses creates	agents of physical	rock types	geologic features, landforms,	original lateral continuity) to	describes how
evidence for	evidence for the	weather.	and chemical	(sedimentary,	Earth materials and geologic	interpret a geologic cross-	biological processes
the	development and	c. Construct an argument that	weathering.	igneous, and	hazards to each plate tectonic	section and describe how unconformities form.	have caused major changes in Earth's
development	composition of Earth's early	predicts weather patterns based	c. Construct an	metamorphic) and	setting.	c. Analyze and interpret data	systems through
and	systems, including the	on interactions among ocean	explanation that	specific plate	d. Ask questions to compare and	from rock and fossil	geologic time (e.g.,
composition	geosphere (crust, mantle and	currents, air masses, and	relates the past	tectonic settings.	contrast the relationship between	succession in a rock	nutrient cycling,
of Earth's	core), hydrosphere and	topography.	and present		transformation processes of all	sequence to interpret major	atmospheric
early systems,	atmosphere. (Clarification	d. Analyze and interpret data to	actions of ice,	SES3. Obtain,	rock types (sedimentary, igneous,	events in Earth's history	composition, and soil
including the	statement: The	show how temperature and	wind, and water to landform	evaluate, and	and metamorphic) and specific	such as mass extinction,	formation).
geosphere (crust, mantle	differentiation by density of Earth into crust, mantle and	precipitation produce the pattern of climate regions	distribution and	communicate	plate tectonic settings e. Construct an argument using	major climatic change, and tectonic events.	c. Ask questions to
and core),	core should be included in	(zones) on Earth.	landscape change.	information to	multiple forms of evidence that	d. Construct an explanation	investigate and communicate how
hydrosphere	this element.)	e. Construct an explanation that	d. Construct an	explore the	supports the theory of plate	applying the principle of	humans depend on
and	c. Develop a model of the	describes the conditions that	argument based	actions of water,	tectonics (e.g., fossils,	uniformitarianism to show	Earth's land and water
atmosphere.	physical composition of	generate extreme weather	on evidence that	wind, ice, and gravity as they	paleomagnetism, seafloor age,	the relationship between	resources, which are
(Clarification	Earth's layers using multiple	events (e.g., hurricanes,	relates the	relate to	etc.).	sedimentary rocks and their	distributed unevenly
statement:	types of evidence (e.g.,	tornadoes, and thunderstorms)	characteristics of	landscape change.		fossils to the environments	around the planet as a
The	Earth's magnetic field,	and the hazards associated with	the sedimentary	d. Construct an	SES3. Obtain, evaluate, and	in which they were formed.	result of past geological
differentiation	composition of meteorites	these events.	materials to the	argument based	communicate information to	e. Construct an argument using spatial	and environmental processes.
by density of	and seismic waves).	f. Construct an argument	energy by which	on evidence that	explore the actions of water,	representations of Earth	d. Analyze and interpret
Earth into	(Clarification statement:	relating changes in global	they were	relates the	wind, ice, and gravity as they	data that interprets major	data that relates
crust, mantle	Earth's layers should include	climate to variation to Earth/sun	transported and	characteristics of	relate to landscape change.	transitions in Earth's history	changes in global
and core	crust, mantle, inner core and	relationships and atmospheric	deposited.	the sedimentary	b. Develop a model of the	from the fossil and rock	climate to natural and
should be	outer core.)	composition.		materials to the	processes and geologic hazards	record of geologically	anthropogenic
included in				energy by which	that result from both sudden and	defined areas. (Clarification	modification of Earth's
this element.)				they were	gradual mass wasting.	statement: Students should	atmosphere and
				transported and		use maps and cross-sections with a focus on Georgia.)	oceans.
				deposited.			

Earth Systems

SES1. Obtain, evaluate, and communicate information to investigate the composition and formation of Earth systems, including the Earth's place in the solar system.

a. Construct an explanation of the origins of the solar system from scientific evidence including the composition, distribution and motion of solar system objects.

(Clarification statement: The nebular hypothesis should be included in this element.)

b. 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.

(Clarification statement: The differentiation by density of Earth into crust, mantle and core should be included in this element.)

c. Develop a model of the physical composition of Earth's layers using multiple types of evidence (e.g., Earth's magnetic field, composition of meteorites and seismic waves).

(*Clarification statement:* Earth's layers should include crust, mantle, inner core and outer core.)

SES2. Obtain, evaluate, and communicate information to understand how plate tectonics creates certain geologic features, landforms, Earth materials, and geologic hazards.

a. Construct an explanation based on evidence that describes the mechanisms causing plate tectonic motion.

(*Clarification statement:* The role of radioactive decay as the source of energy that drives the process of convection should be studied as part of this element).

b. Develop and use models for the different types of plate tectonic settings (convergent, divergent and transform boundaries). (*Clarification statement:* Subduction zones, continental collisions, rift zones, and ocean basins should be included.)

c. Construct an explanation that communicates the relationship of geologic features, landforms, Earth materials and geologic hazards to each plate tectonic setting.

d. Ask questions to compare and contrast the relationship between transformation processes of all rock types (sedimentary, igneous, and metamorphic) and specific plate tectonic settings.

(*Clarification statement:* The plate tectonic settings to be considered here are continental collision, subduction zone, mid-ocean ridge, transformation fault, hot spot, and passive zone.)



e. Construct an argument using multiple forms of evidence that supports the theory of plate tectonics (e.g., fossils, paleomagnetism, seafloor age, etc.).

SES3. Obtain, evaluate, and communicate information to explore the actions of water, wind, ice, and gravity as they relate to landscape change. a. Plan and carry out an investigation that demonstrates how surface water and groundwater act as the major agents of physical and chemical weathering.

b. Develop a model of the processes and geologic hazards that result from both sudden and gradual mass

c. Construct an explanation that relates the past and present actions of ice, wind, and water to landform distribution and landscape change.

d. 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. a. Use mathematics and computational thinking to calculate the absolute age of rocks using a variety of methods (e.g., radiometric dating, rates of erosion, rates of deposition, and varve count).

b. 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.

c. 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.

d. Construct an explanation applying the principle of uniformitarianism to show the relationship between sedimentary rocks and their fossils to the environments in which they were formed.

e. 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.



(Clarification statement: Students should use maps and cross-sections with a focus on Georgia.)

SES5. Obtain, evaluate, and communicate information to investigate the interaction of solar energy and Earth's systems to produce weather and climate.

a. 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.

b. Analyze and interpret data (e.g., maps, meteograms, and weather apps) that demonstrate how the interaction and movement of air masses creates weather.

c. Construct an argument that predicts weather patterns based on interactions among ocean currents, air masses, and topography.

d. Analyze and interpret data to show how temperature and precipitation produce the pattern of climate regions (zones) on Earth.

e. 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.

f. Construct an argument relating changes in global climate to variation to Earth/sun relationships and atmospheric composition.

SES6. Obtain, evaluate, and communicate information about how life on Earth responds to and shapes Earth's systems.

a. 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.

b. Construct an explanation that describes how biological processes have caused major changes in Earth's systems through geologic time (e.g., nutrient cycling, atmospheric composition, and soil formation).

c. 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.

d. Analyze and interpret data that relates changes in global climate to natural and anthropogenic modification of Earth's atmosphere and oceans.