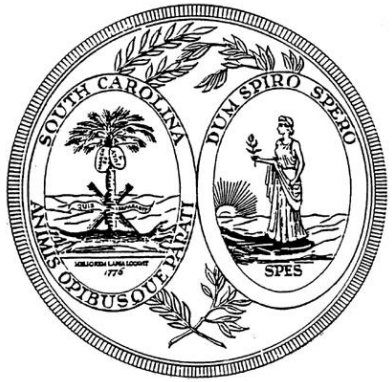
South Carolina Academic Standards and Performance Indicators for Science 2014



Instructional Unit Resource

Earth Science

South Carolina Academic Standards and Performance Indicators for Science 2014
Earth Science Instructional Unit Resource

As support for implementing the *South Carolina Academic Standards and Performance Indicators for Science 2014*, the standards for Earth Science have been grouped into possible units. In the Overview of Units below, the titles for those possible units are listed in columns. Refer to the Overview document to note these unit titles and how Standards, Conceptual Understandings, Performance Indicators, Science and Engineering Practices, and Crosscutting Concepts align. Following the Overview of Units, an Instructional Unit document is provided that delivers guidance and possible resources in teaching our new *South Carolina Academic Standards and Performance Indicators for Science 2014*. The purpose of this document is to provide guidance as to how all the standards in this grade may be grouped into units and how those units might look. Since this document is merely guidance, districts should implement the standards in a manner that addresses the district curriculum and the needs of students. This document is a living document and instructional leaders from around the state will continuously update and expand these resource documents. These documents will be released throughout the 2016-2017 school year with the intentionality of staying ahead of instruction. Teachers should also note that links to the Standards document, A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, the SEP Support Document, and the Support Document 2.0 are embedded throughout the Instructional Unit format for reference.

Acknowledgments

Jean Baptiste Massieu, famous deaf educator, made a statement that is now considered a French proverb. “Gratitude is the memory of the heart. Indeed, appreciation comes when you feel grateful from the depths of your heart. The head keeps an account of all the benefits you received and gave. But the heart records the feelings of appreciation, humility, and generosity that one feels when someone showers you with kindness.” It is with sincere appreciation that we humbly acknowledge the dedication, hard work and generosity of time provided by teachers and instructional leaders across the state that have made and are continuing to make the Instructional Unit Resources possible.

Earth Science Overview of Units

Unit 1		Unit 2		Unit 3	Unit 4	UNIT 5
EARTH SCIENCE: Astronomy		EARTH SCIENCE: Earth's Geosphere		EARTH SCIENCE: Paleobiosphere	EARTH SCIENCE: Atmosphere-Weather and Climate	EARTH SCIENCE: Hydrosphere
Standard		**Standard**		**Standard**	**Standard**	**Standard**
H.E.2		H.E.3		H.E.4	H.E.5	H.E.6
Conceptual Understanding		**Conceptual Understanding**		**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**
H.E.2.A	H.E.2.B	H.E.3A	H.E.3B	H.E.4A	H.E.5A	H.E.6A
Performance Indicators		**Performance Indicators**		**Performance Indicators**	**Performance Indicators**	
H.E.2A.1 H.E.2A.2 H.E.2A.3 H.E.2A.4 H.E.2A.5	H.E.2B.1 H.E.2B.2 H.E.2B.3 H.E.2B.4	H.E.3A.1 H.E.3A.2 H.E.3A.3 H.E.3A.4 H.E.3A.5 H.E.3A.6 H.E.3A.7 H.E.3A.8	H.E.3B.1 H.E.3B.2 H.E.3B.3 H.E.3B.4 H.E.3B.5	H.E4.A.1 H.E.4A.2 H.E.4A.3 H.E.4A.4 H.E.4A.5 H.E.4A.6 H.E.4A.7	H.E.5A.1 H.E.5A.2 H.E.5A.3 H.E.5A.4 H.E.5A.5 H.E.5A.6 H.E.5A.7 H.E.5A.8	H.E.6A.1 H.E.6A.2 H.E.6A.3 H.E.6A.4 H.E.6A.5 H.E.6A.6 H.E.6A.7 H.E.6A.8
***Science and Engineering Practices**		***Science and Engineering Practices**		***Science and Engineering Practices**	***Science and Engineering Practices**	***Science and Engineering Practices**
S.1A.2 S.1A.7 S.1A.4 S.1A.8 S.1A.5 S.1A.6		S.1A.2 S.1A.6 S.1A.3 S.1A.7 S.1A.4 S.1A.8 S.1A.5 S.1B.1		S.1A.2 S.1A.8 S.1A.5 S.1A.6 S.1A.7	S.1A.2 S.1A.4 S.1A.6 S.1A.7	S.1A.1 S.1A.8 S.1A.2 S.1A.3 S.1A.4
***Crosscutting Concepts**		***Crosscutting Concepts**		***Crosscutting Concepts**	***Crosscutting Concepts**	***Crosscutting Concepts**
1,2,3,4,5,7		1,2,4,6,7		1,2,3,4,5	1,2,5,6	2,3,4,5

**Teachers have the discretion to enhance the selected SEP's and CCC's.*

Unit Title
Earth's Paleobioshpere
Standard http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf
Standard H.E.4 The student will demonstrate an understanding of the dynamic relationship between Earth's conditions over geologic time and the diversity of organisms.

Conceptual Understanding
H.E.4A. Living things have changed the makeup of Earth's geosphere, hydrosphere, and atmosphere over geological time. Organisms ranging from bacteria to human beings may contribute to the global carbon cycle. They may influence the global climate by modifying the chemical makeup of the atmosphere. As Earth changes, life on Earth adapts and evolves to those changes. Just as life influences components of the Earth System, changes in the Earth System influences life.
New Academic Vocabulary **Some students may need extra support with the following academic vocabulary in order to understand what they are being asked to understand and do. Teaching these terms in an instructional context is recommended rather than teaching the words in isolation. A great time to deliver explicit instruction for the terms would be during the modeling process. Ultimately, the student should be able to use the academic vocabulary in conversation with peers and teachers. These terms are pulled from the essential knowledge portion of the Support Doc 2.0 (http://ed.sc.gov/instruction/standards-learning/science/support-documents-and-resources/) and further inquiry into the terms can be found there.**

Geologic time	Absolute dating	Sedimentary rock	Ice Cores	Carbon Cycle	Relative dating
Striation	Hydrosphere	Biosphere	Cross Cutting Principle	Fossils	Index fossil
Geologic time scale	Era	Epoch	Global climate	Geosphere	Rock Layers

Performance Indicators **Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's**
H.E.4A.1 *Construct scientific arguments* to support claims that the physical conditions of Earth enable the planet to support carbon-based life. H.E.4A.2 *Construct explanations* for how various life forms have altered the geosphere, hydrosphere and atmosphere over geological time. H.E.4A.3 *Construct explanations* of how changes to Earth's surface are related to changes in the complexity and diversity of life using evidence from

the geologic time scale.
H.E.4A.4 *Obtain and evaluate evidence* from rock and fossil records and ice core samples to support claims that Earth's environmental conditions have changed over time.
H.E.4A.5 *Develop and use models* of various dating methods (including index fossils, ordering of rock layers, and radiometric dating) to estimate geologic time.
H.E.4A.6 *Use mathematical and computational thinking* to calculate the age of Earth materials using isotope ratios (actual or simulated).
H.E.4A.7 *Develop and use models* to predict the effects of an environmental change (such as the changing life forms, tectonic change, or human activity) on global carbon cycling.

***Science and Engineering Practices**

Support for the guidance, overviews of learning progressions, and explicit details of each SEP can found in the Science and Engineering Support Doc (http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf). It is important that teachers realize that the nine science and engineering practices are not intended to be used in isolation. Even if a performance indicator for a given standard only lists one of the practices as a performance expectation, scientists and engineers do not use these practices in isolation, but rather as part of an overall sequence of practice. When educators design the learning for their students, it is important that they see how a given performance expectation fits into the broader context of the other science and engineering practices. This will allow teachers to provide comprehensive, authentic learning experiences through which students will develop and demonstrate a deep understanding of scientific concepts.

H.E. 1A.2 Develop and Use Models - Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
H.E..1A.5 Use Mathematics and Computational Thinking - Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.
H.E.1A.6 Construct Explanations - Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
H.E.1A.7 Engage in Scientific Argument from Evidence - Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
H.E.1A.8 Obtain, Evaluate, and Communicate Information - Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

***Cross Cutting Concepts** (http://www.nap.edu/read/13165/chapter/8)

The link above provides support from the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) The text in blue and *italicized/underlined* below provides a brief explanation of how the specific content ties to the CCC's.

1. Patterns: The National Research Council (2012) states that "observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them" (p. 84). *Evidence found in rock layers has allowed scientists to develop a geologic history of the Earth.*

2. Cause and effect: Mechanism and explanation: The National Research Council (2012) states that "events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts" (p. 84). *Earth's geologic, hydrosphere, and atmospheric processes contribute to the extinction of species and other changes in plant, animal, and microbial populations.*

3. Scale, proportion, and quantity: The National Research Council (2012) states that "in considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance" (p. 84). *Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale and geologists use relative positions to estimate dates.*

4. Systems and systems models: The National Research Council (2012) states that "Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering" (p. 84). *Environmental changes can have an effect on global carbon cycling. Modeling helps predict the impact of such changes.*

5. Energy and matter: Flows, cycles, and conservation: The National Research Council (2012) states that "tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations" (p. 84). *Carbon dioxide and oxygen are used in the process of photosynthesis and respiration in the never ending carbon-oxygen cycle.*

**Teachers have the discretion to enhance the selected SEP's and CCC's.*

Prior Knowledge

- 6.L.5 Photosynthesis

- 6.E.2 Atmospheric layers
- 8.E.4 Earth's solar system
- 8.E.5 Rock layers and fossils; weathering and erosion
- 8.E.6 Biological adaptation and genetic variation; geological time periods; impact of events on the conditions of Earth; fossils fuels and rock layers

Subsequent Knowledge

- H.B. 3 Photosynthesis
- H.B. 4 Biological adaptation and genetic variation
- H.C. 2 Radioactive dating

Possible Instructional Strategies/Lessons

- Earth It is Kind of a Big Deal: Students will obtain and evaluate data concerning Earth and create marketing plans to sell the Earth. They will use Earth's unique characteristics to market their advertising campaign. The resource can be found at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwj35oT4xfnOAhVDGh4KHduTDXoQFgggMAA&url=http%3A%2F%2Fwiki.coe.jmu.edu%2FMSME%2Fadmin%2Fdownload.html%3Fattachid%3D2176515&usg=AFQjCNHo7h5rmzn27nDTdeibd7icN7v2gQ

- History of the Earth's Atmosphere: Students will develop and construct a historical timeline in the form of a sequential storyboard. This storyboard will help to illustrate the events that influenced the composition of Earth's early atmosphere. The students will visually organize and illustrate the climatic change that occurred on Earth when photosynthetic bacteria began producing excess oxygen. The resource can be found at http://ims.ode.state.oh.us/ODE/IMS/Lessons/Content/CSC_LP_S01_BC_L10_I04_01.pdf

- Thinking About Life In Geologic Timescales: Students will construct a large (classroom-sized) timeline showing the history of life on Earth for the last 5 billion years. Students will be able to identify the events that are relevant to their taxonomic projects (the origins and important developments in their groups' study taxa). Students will relate how changes to Earth's surface are related to changes in the complexity and diversity of life using evidence from the geologic time scale. The resource can be found at http://gk12calbio.berkeley.edu/lessons/less_geotime.html

- Tour Through Time: Interactive tour through 4 billion years of life on Earth allowing student to analyze and interpret data and create arguments based on fossil evidence. The resource can be found at http://archive.fieldmuseum.org/evolvingplanet/POST/EP_V8.swf

- Air The Search for One Clean Breath: Students will obtain and evaluate evidence that the chemical composition of the Earth's ancient atmosphere is recorded in layers of ice. They will learn how paleo-climatology developed from studying ice core data from polar regions. Students will observe, measure, and analyze the changes of balloon contents from solid to liquid/gaseous states. The resource can be found at http://www.vcacd.org/ApirTheFilm/pubs/CarbonDioxideinIceCoreSamplesLessonPlan.pdf

- Who's on First? A Relative Dating Activity: Students will create models and sequence information using items which overlap specific sets of fossils and relate sequencing to the Law of Superposition; this includes how fossils can be used to give relative dates to rock layers. The resource can be found at http://www.ucmp.berkeley.edu/fosrec/BarBar.html

- Virtual Museum of Fossils: By following hot links, students can find an animal, choose a time, or take a tour exploring photographs of fossils and use that information to construct explanations and support claims about changing environmental conditions over time. The resource can be found at http://fossils.valdosta.edu/about_site.html

- Layers of Time Fossil Game: Students work through the interactive lesson which allows them to analyze data and construct explanations as to how the fossil record and the history of life on Earth fit together. The resource can be found at http://www.amnh.org/ology/features/layersoftime/game.php

- Whodunit? and the law of superposition. Students will engage in scientific argument based on fossil evidence and apply what they have learned to determine a sequence of hypothetical geological events and their relative age. The resource can be found at http://earthquake.usgs.gov/learn/teachers/WhoDunit.pdf

- Model global warming: Students will use this interactive to create models of the effects of global warming and then test and create their own models. The resource can be found at http://www.windows2universe.org/teacher_resources/teach_climatemodel.html

- Date A Rock: Students model simulated samples to calculate the age of the Earth using radioactive isotopes. The resource can be found at http://www.indiana.edu/~ensiweb/lessons/date.les.html

Resources
● The Movie Air: The Search for One more Breath. This video is used in conjunction with the history of the atmosphere activity, but can be used solely for reference material. The resource can be found at https://www.youtube.com/watch?v=0nzPILVfLAo ● National Ice core data facility. This website contains ice core data from around the world to use for research purposes. The resource can be found at http://icecores.org/
Sample Formative Assessment Tasks/Questions
● Teacher gives direction to students. Students formulate individual response, and then turn to a partner to share their answers. Teacher calls on several random pairs to share their answers with the class. ● Think Pair Share-Students think individually, write their thinking, pair and discuss with partner, then share with the class. ● Partner up – giver and receiver (similar to "Password" or "Pyramid") Both know the category, but the receiver has his back to the board/screen. A set of terms will appear based on the category – giver gives clues, while receiver tries to guess the terms. The first group finished stands up. ● Students choose a corner based on their level of expertise of a given subject. Based on your knowledge of _____ , which corner would you choose? Corner 1: The Dirt Road –(There's so much dust, I can't see where I'm going! Help!!) Corner 2: The Paved Road(It's fairly smooth, but there are many potholes along the way.) Corner 3: The Highway (I feel fairly confident but have an occasional need to slow down.) Corner 4: The Interstate (I 'm traveling along and could easily give directions to someone else.) Once students are in their chosen corners, allow students to discuss their progress with others. Questions may be prompted by teacher. Corner One will pair with Corner Three; Corner Two will pair with Corner four for peer tutoring ● Display 6 questions from the lesson Have students in groups of 4. Each group has 1 die. Each student rolls the die and answers the question with the corresponding number. If a number is rolled more than once the student may elaborate on the previous response or roll again. Responses may be written.

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