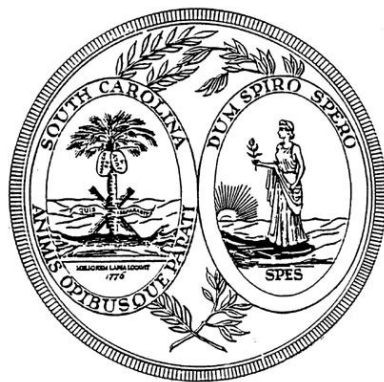


South Carolina Academic Standards and Performance Indicators for Science 2014



Instructional Unit Resource

Biology

South Carolina Academic Standards and Performance Indicators for Science 2014

Biology Instructional Unit Resource

As support for implementing the *South Carolina Academic Standards and Performance Indicators for Science 2014*, the standards for Biology 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.

Biology 1 Overview of Units

Unit 1				Unit 2	Unit 3			
Cells as a System				Energy Transfer	Heredity - Inheritance and Variation of Traits			
Standard				Standard	Standard			
H.B.2				H.B.3	H.B.4			
Conceptual Understanding				Conceptual Understanding	Conceptual Understanding			
H.B.2A	H.B.2B	H.B.2C	H.B.2D	H.B.3A	H.B.4A	H.B.4B	H.B.4C	H.B.4D
Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators
H.B.2A.1 H.B.2A.2	H.B.2B.1 H.B.2B.2 H.B.2B.3	H.B.2C.1 H.B.2C.2 H.B.2C.3	H.B.2D.1 H.B.2D.2 H.B.2D.3 H.B.2D.4	H.B.3A.1 H.B.3A.2 H.B.3A.3 H.B.3A.4 H.B.3A.5	H.B.4A.1 H.B.4A.2	H.B.4B.1 H.B.4B.2	H.B.4C.1 H.B.4C.2 H.B.4C.3	H.B.4D.1
*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices
H.B.1A.6 H.B.1A.3	H.B.1A.2 H.B.1A.6 H.B.1A.8	H.B.1A.1 H.B.1A.2 H.B.1A.4	H.B.1A.2 H.B.1A.6 H.B.1A.7	H.B.1A.2 H.B.1A.3 H.B.1A.7	H.B.1A.2	H.B.1A.2 H.B.1A.8	H.B.1A.2 H.B.1A.4 H.B.1A.6	H.B.4A.2
*Cross cutting Concepts				*Cross cutting Concepts	*Cross cutting Concepts			
2, 4, 5, 6, 7				2, 4, 5	2, 3, 4, 6			

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

Biology 1 Overview of Units

Unit 4	Unit 5			
Evolution	Ecosystem Dynamics			
Standard	Standards			
H.B.5	H.B.6			
Conceptual Understanding	Conceptual Understanding			
N/A	H.B.6A	H.B.6B	H.B.6C	H.B.6D
Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators	Performance Indicators
H.B.5.1 H.B.5.2 H.B.5.3 H.B.5.4 H.B.5.5 H.B.5.6 H.B.5.7	H.B.6A.1 H.B.6A.2	H.B.6B.1 H.B.6B.2	H.B.6C.1	H.B.6D.1
*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices	*Science and Engineering Practices
<i>*This standard is currently based on the 2005 Standards document.</i>	H.B.1A.4 H.B.1A.5	H.B.1A.2 H.B.1A.4	H.B.1A.7	H.B.1B.1
*Cross Cutting Concepts	*Cross Cutting Concepts			
1, 2, 3, 7	1, 2, 4, 5, 7			

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

Unit Title
Biology: Ecosystem Dynamics
Standard
http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf
H.B.6 The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.

Conceptual Understanding					
H.B.6A Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Limiting factors include the availability of biotic and abiotic resources and challenges such as predation, competition, and disease.					
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.					
Population	Species	Abiotic	Biotic	Carrying capacity	Competition
Predation	Density-dependent factor	Density-independent factor	Ecosystem	Community	Immigration
Emigration	Individual	Biome	Biosphere	Commensalism	Mutualism
Interdependence	Exponential growth	Logistic growth	Saprophytic relationship	Saprophyte	Random distribution
Clumped distribution	Even distribution				
Performance Indicators					
Text highlighted below in <i>orange</i> and <i>italicized/underlined</i> shows connections to SEP's.					
H.B.6A.1 <i>Analyze and interpret data</i> that depict changes in the abiotic and biotic components of an ecosystem over time or space (such as percent change, average change, correlation and proportionality) and propose hypotheses about possible relationships between the changes in the abiotic					

components and the biotic components of the environment.

H.B.6A.2 Use mathematical and computational thinking to support claims that limiting factors affect the number of individuals that an ecosystem can support.

***Science and Engineering Practices**

Support for the guidance, overviews of grade level progressions, and explicit details of each SEP can be 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.B.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.B.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, and (3) use grade-level appropriate statistics to analyze data.

***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). Populations have predictable growth patterns based on their availability of resources.
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). Changes in a biotic or abiotic factor in an ecosystem can lead to changes in other biotic or abiotic factors.
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). [Ecosystems are composed of the community of organisms and the abiotic factors that affect them.](#)

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). [Some solar energy is heat, and the heat gets trapped in the Earth’s atmosphere because of an increase in carbon dioxide and other greenhouse gases.](#)

7. **Stability and change:** The National Research Council (2012) states that “For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study” (p. 84). [Extreme fluctuations in a biotic or abiotic factor can affect the stability of an ecosystem.](#)

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

Prior Knowledge

- 6.L.4B.2 Adaptations
- 6.L.4B.3 Animal Responses to the Environment
- 7.EC.5 Abiotic/biotic factors, Levels of organization in ecosystem, Natural hazards, Limiting factors and climate

Subsequent Knowledge

- H.E.3B Sustainability of Human Societies and Management of Natural Resources
- H.E.5A.8 Human Activities and Climate Change) H.E.6A.4 (Watersheds and the Ecosystem

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

- H.B.6A.1
 - Lesson of the Kaibab: Students will analyze and interpret data about a hypothetical population of kaibab to propose hypotheses about the abiotic and biotic factors of that environment. This activity can be used as a starting point to discuss carrying capacity and habitat management. An extension of this activity can include developing a local wildlife management plan for populations of deer, fish, etc. This resource can be found at <https://www.biologycorner.com/worksheets/kaibab.html>
 - Virtual Lab: Model Ecosystems: Students will analyze simplified structures of five different ecosystems, and construct meaning from

the patterns created when organisms are added or decreased at different trophic levels. An extension of this activity can include developing a food web of local species, and then making predictions of impacts of increasing or decreasing populations at various trophic levels. Resource can be found at http://www.mhhe.com/biosci/genbio/virtual_labs/BL_02/BL_02.html

- Creating Chains and Webs to Model Ecological Relationships: Based on the HHMI short film, *The Guide* (See resources below), students identify organisms at different trophic levels to model a food web, then use “cards” to model food chains and webs, and predict what will happen when they are subjected to an ecological disturbance. This resource can be found at <http://www.hhmi.org/biointeractive/creating-chains-and-webs-model-ecological-relationships>

- H.B.6A.2

- Virtual Lab: Population Biology: Students will grow two species of paramecia together, and investigate what biotic and abiotic factors affect population density. Coupled with a “pond water tour” using microscopes and a local source for algae and protists, students can develop ideas about individual species’ niche, competition, and environmental carrying capacity. This resource can be found at http://glencoe.mheducation.com/sites/dl/free/0078802849/383928/BL_04.html
- African Lions: Modeling Populations: In this activity, students investigate exponential and logistic growth of populations of African Lions in order to identify carrying capacity. This resource can be found at <https://concord.org/stem-resources/african-lions-modeling-populations>

Resources

- Population Ecology 3D Animation: This animation models population growth and limiting factors. This resource is available from https://www.youtube.com/watch?v=qA8_q5vEE-8
- National Ocean Service: Harmful Algal Blooms: This website provides information regarding the environmental and human induced limiting factors that influence the overgrowth of algal species, as well as the impact of these HAB’s on the environment. This resource can be found at <http://oceanservice.noaa.gov/facts/redtide.html>
- The Guide: A Film by Jessica Yu: Classroom version: This short film details one young man’s journey to become a scientist in order to preserve Gorongosa National Park in Mozambique. This film goes with the “Creating chains and webs to model ecological relationships”

activity above. This resource is available from <http://www.hhmi.org/biointeractive/guide-biologist-gorongosa>

- *Symbiosis: Mutualism, Commensalism, and Parasitism*: This video clip by Untamed Science gives real world and animated examples of ecological relationships. This resource can be found at <https://www.youtube.com/watch?v=zSmL2F1t81Q>

Sample Formative Assessment Tasks/Questions

Additional sample formative assessment tasks/questions for grade bands are located at the end of each of the SEP Support Doc

(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

Provide students with a picture or diagram of a real-world ecosystem.

- H.B.6A.2
 - Have students identify several possible limiting factors and explain whether or not they are density dependent or density independent.
- H.B.6A.1
 - Prior to the assessment, create a number of “disturbance cards” that each have a different ecological disturbance on them. Give each student a different “disturbance card” and have them predict how the disturbance will affect the ecosystem’s stability, the organisms, and what will happen to the ecosystem in both the short and long term. (This goes with H.B.6C as well).

Unit Title

Biology: Ecosystem Dynamics

Standard

http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

H.B.6 The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.

Conceptual Understanding

H.B.6B Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes

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.

Photosynthesis	Cellular respiration	Carbon cycle	Heterotroph	Autotroph	Geosphere
Carbon	Greenhouse gas	Carbon dioxide	Methane		

Performance Indicators

Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's.

H.B.6B.1 *Develop and use models* of the carbon cycle, which include the interactions between photosynthesis, cellular respiration and other processes that release carbon dioxide, to evaluate the effects of increasing atmospheric carbon dioxide on natural and agricultural ecosystems.
H.B.6B.2 *Analyze and interpret quantitative data* to construct an explanation for the effects of greenhouse gases (such as carbon dioxide and methane) on the carbon cycle and global climate.

*Science and Engineering Practices

Support for the guidance, overviews of grade level progressions, and explicit details of each SEP can be 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.B.1A.2 *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.B.1A.4 *Analyze and interpret data* from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

*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). *Photosynthesis and cell respiration are two processes that continually cycle carbon dioxide and oxygen through the carbon cycle.*

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). *When the amount of carbon dioxide in the atmosphere increases, the rate of carbon fixation in photosynthesis increases.*
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). *The carbon cycle is a system maintaining the amount of carbon being cycled via the processes of photosynthesis, cell respiration, decomposition, storing of organic molecules, and combustion.*
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). *Some solar energy is heat, and the heat gets trapped in the Earth’s atmosphere because of an increase in carbon dioxide and other greenhouse gases.*
7. **Stability and change:** The National Research Council (2012) states that “For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study” (p. 84). *A change in the amount of atmospheric carbon dioxide leads to a change in the rate of photosynthesis and average global temperature. An increase in the average global temperature leads to the greenhouse effect.*

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

Prior Knowledge
6.L.4 Autotrophs and heterotrophs 6.L.5 Photosynthesis, Respiration and Transpiration, Carbon Dioxide
Subsequent Knowledge
- H.B.3 Photosynthesis and Respiration - H.E.4 Effects of environmental change on carbon cycle, Altering of geosphere, hydrosphere and atmosphere

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

- H.B.6B.1
 - Roleplay Carbon Cycle: In this activity/game, students will role play what is happening during the carbon cycle. Teachers should set up the room as the areas where the processes of the carbon cycle will take place. From this, students should be able to develop a model of the carbon cycle. This activity can be found at http://oceanservice.noaa.gov/education/pd/climate/teachingclimate/carbon_cycle_game.pdf
 - Carbon Transfer Through Snails and Elodea: This virtual investigation allows students to design a lab to investigate the relationship between plants and animals in the carbon cycle. This resource is available from http://www.classzone.com/cz/books/bio_07/resources/htmls/virtual_labs/virtualLabs.html
- H.B.6B.2
 - The Greenhouse Effect: This simulation lets students adjust different environmental conditions in order to explore changes in temperature due to the greenhouse effect. Teachers can have students explore on their own or do a whole class demonstration of the simulation. This simulation can be found at <https://phet.colorado.edu/en/simulation/greenhouse>
 - Activity 3: Analyzing Greenhouse Data: This activity provides data charts for students to analyze and interpret quantitative data to construct an explanation for the effects of the greenhouse gases on the carbon cycle. This activity can be found at http://www.rhfleet.org/sites/default/files/files/lesson-plans/tw_GreenhouseWarmingWhatIsIt.pdf

Resources

- The Global Carbon Cycle Animation: This animation details the factors that influence the global carbon cycle, as well as the effect of human activities on the increase of greenhouse gases. Teachers can create a self-paced guide to accompany this source and reinforce thinking. This resource can be found at <http://www.sumanasinc.com/webcontent/animations/content/globalcarboncycle.html>
- Habitable Planet: Carbon Lab (simulation): This simulation allows student to analyze simulation data to develop inferences of how human activities may change global carbon cycles. This resource can be found at <https://www.learner.org/courses/envsci/interactives/carbon/>

Sample Formative Assessment Tasks/Questions

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(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

- H.B.6B.1 & H.B.6B.2
 - Provide students with a diagram of the Carbon Cycle. Give students several hypothetical situations (e.g. a power plant is built near an ecosystem, a forest is clear-cut, a factory is abandoned, rain forest is replanted, etc.) and have them analyze and explain how the change would affect the carbon cycle in the ecosystem and the greenhouse effect globally.

Unit Title

Biology: Ecosystem Dynamics

Standard

http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

H.B.6 The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.

Conceptual Understanding

H.B.6C A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively stable over long periods of time. Fluctuations in conditions can challenge the functioning of ecosystems in terms of resource and habitat availability.

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.

Dynamic equilibrium Homeostasis

Performance Indicators

Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's.

H.B.6C.1 *Construct scientific arguments* to support claims that the changes in the biotic and abiotic components of various ecosystems over time affect the ability of an ecosystem to maintain homeostasis.

*Science and Engineering Practices

Support for the guidance, overviews of grade level progressions, and explicit details of each SEP can be 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.B.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.

*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.

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). *Any disturbance to the ecosystem will affect the rate of succession in a particular area.*

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). *Changes in biotic or abiotic factors can affect the ability of the ecosystem to maintain homeostasis.*

7. **Stability and change:** The National Research Council (2012) states that “For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study” (p. 84). *A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively stable over long periods of time.*

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

Prior Knowledge

- 7.EC.5 Abiotic/biotic factors, Natural hazards, limiting factors, climate, immigration and emigration, competition, mutualism, commensalism, parasitism, and predator/prey relationships, interdependence.

Subsequent Knowledge

- H.E.3B.3 Geologic events and human history

- H.E.3B.4 Human activities and natural hazards
- H.E.3B.5 Locally significant natural hazards

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

- H.B.6C.1
 - Ecosystem Dynamics Predictions: Have students view the Bozeman Science video *LS2C: Ecosystem Dynamics, Functioning, and Resilience* (see Resources). After viewing the video (or similar instructional material), the teacher should provide the students in groups with various ecosystems (with specific descriptions) with varying levels of biodiversity. The teacher then should give each group a different disturbance (e.g. fire, flood, volcano, hurricane, etc.). Each group should then work together to predict which ecosystem will be the most resilient to the disturbance and why, and predict the specific effects of the disturbance on each ecosystem. (See Sample Formative Assessment Tasks to use this activity to assess students)
 - Succession Picture Sort: provide students with cards/illustrations showing an ecosystem at different stages of primary and secondary succession. Have students work in groups to try and sort the pictures to place them in the order that they think they occur in nature. Once they have their hypothesis sequences developed, they should watch the Amoeba Sisters video *Ecological Succession: Nature's Great Grit* (or some other similar instructional resource). The students should then revise their hypotheses based on the instructional material. (See Sample Formative Assessment Tasks to use this activity to assess students)

Resources

- LS2C - Ecosystem Dynamics, Functioning and Resilience: This video from Bozeman science details different disturbances that can occur in ecosystems and how biodiversity can increase the stability and resilience of ecosystems. This resource is available from <https://www.youtube.com/watch?v=jFBCBmK9E3U>
- Ecological Succession: Nature's Great Grit: This Amoeba Sisters video details the processes of primary and secondary succession. This resource is available from <https://www.youtube.com/watch?v=uqEUzgVAF6g>
- Primary and Secondary Succession Interactive. This interactive learning module allows students to manipulate the amount of rainfall and temperature to a newly formed volcanic island, as well as observe the successional events following a forest fire. This resource can be found at <http://biologiepagina.nl/Flashfiles/successie.swf>

Sample Formative Assessment Tasks/Questions

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(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

- H.B.6C.1
 - Ecosystem Dynamics Predictions Presentation: After completing the Ecosystem Dynamics Predictions activities, have students create presentations that use their predictions as justification to support the claim that, changes in biotic or abiotic components of ecosystems affect the ability of the ecosystem to maintain homeostasis.
 - Succession Picture Sort Summary: After completing the Succession Picture Sort above, have students use their sorted pictures to create a “comic summary” (i.e. each picture is a frame of a comic strip) of the processes of primary and secondary succession.
 - See Assessment for H.B.6A.1

Unit Title

Biology: Ecosystem Dynamics

Standard

http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

H.B.6 The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.

Conceptual Understanding

H.B.6D Sustaining biodiversity maintains ecosystem functioning and productivity which are essential to supporting and enhancing life on Earth. Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity can impact biodiversity.

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.

Biodiversity

Ecological community

Natural resource

Invasive species

Natural hazards

Habitat
fragmentation

Pollution	Ecological restoration	Endangered species
Performance Indicators Text highlighted below in <i>orange</i> and <i>italicized/underlined</i> shows connections to SEP's.		
H.B.6D.1 <i>Design solutions</i> to reduce the impact of human activity on the biodiversity of an ecosystem.		
*Science and Engineering Practices Support for the guidance, overviews of grade level progressions, and explicit details of each SEP can be 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.B.1B.1 <i>Construct devices or design solutions</i> using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.		
*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 <i>blue</i> and <i>italicized/underlined</i> below provides a brief explanation of how the specific content ties to the CCC's.		
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). <i>Human activity can impact biodiversity.</i>		
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). <i>Sustaining biodiversity maintains ecosystem functioning and productivity which are essential to supporting and enhancing life on Earth.</i>		
7. Stability and change: The National Research Council (2012) states that “For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study” (p. 84). <i>A loss of biodiversity has long-term effects and can</i>		

[reduce an ecosystem's stability.](#)

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

Prior Knowledge

- 7.EC.5 Soil Quality, Non-native and invasive species, Carrying Capacity

Subsequent Knowledge

- H.E.3B.3 Geologic Events and Human History
- H.E.3B.4 Human Activities and Natural Hazards
- H.E.3B.5 Locally Significant Natural Hazards

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

- H.B.6D.1
 - National Geographic: The Human Footprint: This series of lessons include activities that allow students to develop action plans to reduce ecological footprints and analyze how human influence has changed landscapes and biodiversity. This resource can be found at <http://www.nationalgeographic.com/xpeditions/lessons/14/g68/HumanFootprint.pdf>
 - Personal Footprint Analysis: Have students collect their household and food waste materials (eg. food wrappers, containers, etc.), and log the meals they eat over the course of several days, as a visual representation. Use the Global Network Footprint Calculator (see Resources) and have students analyze their individual impact on the environment. Reinforce this concept by showing short segments of National Geographic's *The Human Footprint* video (see resources). As an extension, have students develop a plan of action to reduce their waste and product consumption. Once they have created their plans, have them share with their families and report the feedback they received.
 - Design-a-Solution Project: Have students choose a specific, local ecological problem caused by humans. Students should research how humans cause the problem, the impact of the problem on the local ecosystem, and possible solutions to alleviate the impacts of the problem. Emphasize that at least one of the solutions must be designed by the student himself or herself. Students could then be required to implement one solution from their project, or the class could vote on one or two solutions to implement together. Students could then create presentation for an assessment (see Suggested Assessment Tasks).

- Evaluating Population Growth Trend & Environmental Impact: Students can use population simulations (see resources), printed data sources, or information from the United States Census Bureau to analyze local and/or global demographic data. Each student can choose or be provided a country or area to investigate. After reviewing the histograms and economic data for each of their areas, students can then begin to make predictions about patterns of growth, environmental impacts, resource availability, and biodiversity impacts.

Resources

- HB.6.D.1

- The Anthropocene: Human Impact on the Environment Simulations: This interactive models the effects of human activity on the environment, and what impact that will have on the fossil record in terms of biological diversity. Students will analyze various data points to determine patterns that correlate human activity to negative environmental impacts. This resource can be found at <http://www.hhmi.org/biointeractive/anthropocene-human-impact-environment>
- Mix and Match Ecology: Human Impact: This activity allows students to explain the causal relationship between human actions and ecological impact. This activity can be extended to allow students to design solutions to reduce the impact of human activity. This resource can be found at <http://www.learnnc.org/lp/media/uploads/2008/12/ecologyworksheet.pdf>
- Analyzing the Distribution of Vegetation Zones and Mountain Gorillas in Virunga National Park: This series of lessons allows students to analyze biotic and abiotic factors that influence the distribution of mountain gorillas in Virunga National Park, and then develop conclusions about why the populations of gorillas have diminished within the habitable zones. This resource can be found at <http://nationalgeographic.org/activity/analyzing-distribution-vegetation-zones-and-mountain-gorillas-virunga-national-park/>
- The Human Footprint: National Geographic: This video series details the amount of waste and products consumed, including production cost, by a typical American in their lifetime. This resource can be found at <https://www.youtube.com/watch?v=VcxQjGPDKE&list=PLfEPWuMR8I9ctnB1VmkDPaltRpWjfkfT>
- Footprint Calculator: Global Footprint Network: This simulation allows students to calculate their individual ecological footprint, and then develop solutions to reduce their impact on the environment. This resource can be found at <http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/>
- Population Simulation: This simulation gives general demographic data for six geographic zones. Students are then able to analyze

growth trends, and make predictions about future demographics. Extensions of this activity can include evaluating the effect of those demographics on the availability of food, land usage, biogeochemical cycles, etc. This resource can be found at https://www.ined.fr/en/everything_about_population/population-games/tomorrow-population/.

- o Local and World Population Data: The U.S. Census Bureau provides demographic information at the local, state, national, and global levels. This data can be used a variety of ways to allow students to make predictions about the implication of the increase or decrease in population size, and how some areas may have more or less of an impact on the ecosystem. This resource can be found at <http://www.census.gov/data.html>
- o National Ocean Service: Harmful Algal Blooms: (see H.B.6A.2 resources)

Sample Formative Assessment Tasks/Questions

Additional sample formative assessment tasks/questions for grade bands are located at the end of each of the SEP Support Doc

(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

- Design-a-Solution Project Presentation: The students would briefly present a summary of their work in the Design-a-Solution project: the problem, solutions, and how their implementation might have helped alleviate the problem. They could be required to do a live presentation with a visual aid (PowerPoint or Keynote) or a video that includes pictures/videos of their problem and implemented solution.

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