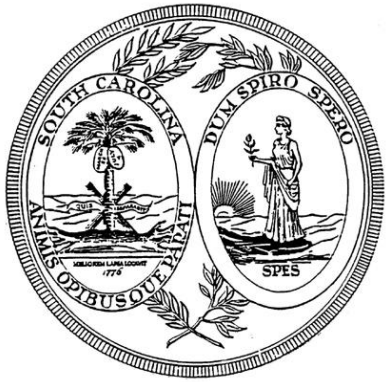
South Carolina Academic Standards and Performance Indicators for Science 2014



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
***Crosscutting Concepts**				***Crosscutting Concepts**	***Crosscutting 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**
**This standard is currently based on the 2005 Standards document.*	H.B.1A.4 H.B.1A.5	H.B.1A.2 H.B.1A.6	H.B.1A.7	H.B.1B.1
***CrossCutting Concepts**	***CrossCutting Concepts**			
1, 2, 3, 7	1, 2, 3, 4, 5, 6, 7			

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

Unit Title
Biology: Energy Transfer
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.3 The student will demonstrate the understanding that all essential processes within organisms require energy which in most ecosystems is ultimately derived from the Sun and transferred into chemical energy by the photosynthetic organisms of that ecosystem.

Conceptual Understanding
H.B.3A. Cells transform energy that organisms need to perform essential life functions through a complex sequence of reactions in which chemical energy is transferred from one system of interacting molecules to another.
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.**

Adenosine triphosphate	light-independent reactions	Anerobic respiration	Electron transport chain
Photosynthesis	Calvin Cycle	Cellular respiration	Fermentation
Light-dependent reactions	Aerobic respiration	Krebs cycle	

Performance Indicators **Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's.**
H.B.3A.1 *Develop and use models* to explain how chemical reactions among ATP, ADP, and inorganic phosphate act to transfer chemical energy within cells. H.B.3A.2 *Develop and revise models* to describe how photosynthesis transforms light energy into stored chemical energy. H.B.3A.3 *Construct scientific arguments to support claims* that chemical elements in the sugar molecules produced by photosynthesis may interact with other elements to form amino acids, lipids, nucleic acids or other large organic molecules. H.B.3A.4 *Develop models* of the major inputs and outputs of cellular respiration (aerobic and anaerobic) to exemplify the chemical process in which

the bonds of molecules are broken, the bonds of new compounds are formed and a net transfer of energy results.
H.B.3A.5 *Plan and conduct scientific investigations or computer simulations* to determine the relationship between variables that affect the processes of fermentation and/or cellular respiration in living organisms and interpret the data in terms of real-world phenomena.

***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.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.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
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: The National Research Council (2012) states "Students argue from evidence when making a causal claim about an observed phenomenon" (p. 84). *As ATP becomes ADP, an inorganic phosphate is released.*

4. Systems and system models: The National Research Council (2012) states "Identify assumptions and approximations built into models. Discuss limitations to precision and reliabilities to predictions. Modeling using mathematical relationships provides opportunities to critique models and text and to refine design ideas "(p. 84). *Photosynthesis is responsible for producing a source of carbon in the sugar molecule that assists in forming other major macromolecular components.*

5. Energy and matter: Flows, cycles, and conservation: The National Research Council (2012) states "Fully develop energy transfers. Introduce nuclear substructure and conservation laws for nuclear processes" (p. 84). *Energy is conserved as electrons are released by electron acceptors*

during the electron transport chain.

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

Prior Knowledge
• 6.P.3A.1 Chemical Energy • 6.L.4A.2 Cellular characteristics in Extended Knowledge • 6.L.5B.2 Photosynthesis, Respiration, and Transpiration,; Chloroplasts, Chlorophyll, Stomata, and Guard Cells • 7.L.3A.2 Cell types • 7.L.3A.3 Cell structure and function • 7.P.2B.5 Chemical Reactions and Conservation of Matter
Subsequent Knowledge
• H.C.6A.1 Balancing reactions • H.C.3A.6 Molecular Structure

Possible Instructional Strategies/Lessons

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

- Model the ATP-ADP Cycle Using the ATP Cycle resource and have students create a "functional" model of ATP using whatever resources are available. The model should have some way to add and remove a phosphate group and some representation of the energy absorbed and released in the cycle. The ATP Cycle resource can be found at: http://www.anytimeeducation.com/the-atp-cycle/

- Storyboarding Students create storyboards modeling the processes of photosynthesis and cellular respiration. Students should focus on the inputs and outputs of the reactions and how each step references the overall chemical equations.

- The Floating Leaf Disk Assay for Investigating Photosynthesis This activity provides a visual for students as leaf disks, affected by the amount of oxygen produced during photosynthesis, float to the top of the beaker. This activity is available at https://blogs.cornell.edu/cibt/files/2015/09/Floating-Leaf-Disk-Brad-Williamson.pdf

- Exercise and Cell Respiration Lab Students will conduct investigations to test variables that affect fermentation and cell respiration by performing different exercises and exhaling into bromothymol blue solution to determine the amount of carbon dioxide produced. This lab is available at http://www.westbranch.k12.oh.us/userfiles/293/classes/1769/exercisecellularrespirationlab.pdf

- Testing for lipids, proteins, and carbohydrates lab This lab can be adapted to include only plant-based food items for testing. By identifying these macromolecules derived from plant tissues, students can gather evidence to argue the claim that the sugars produced in photosynthesis combine with other elements to form the needed macromolecules for the plant. This lab is available from http://www.seplessons.org/node/362

Resources

- Photosynthesis - A Survival Guide for Teachers Teaching resources (notes, powerpoints, technical guide) that assist in model development of conversion between light energy to stored chemical energy. This resource can be found at http://www.saps.org.uk/secondary/teaching-resources/134-photosynthesis-a-survival-guide-teaching-resources

- Photosynthesis and Respiration A list of activities and labs to help model inputs, outputs, broken molecules, and energy conversions pertaining to photosynthesis and respiration. This resource can be found at http://www.nclark.net/PhotoRespiration.

- Photosynthesis and the Teeny Tiny Pigment Pancakes This Amoeba Sisters video models the process of Photosynthesis and shows energy transformation. This video is available from https://www.youtube.com/watch?v=uixA8ZXx0KU&list=PLwL0Myd7Dk1F0iQPGrjehze3eDpco1eVz&index=9

- Cell Respiration and the Mighty Mitochondria This Amoeba Sisters video models the process of cellular respiration to show how molecules are broken and energy is transferred. This video is available from https://www.youtube.com/watch?v=4Eo7JtRA7lg&list=PLwL0Myd7Dk1F0iQPGrjehze3eDpco1eVz&index=8

- Illuminating Photosynthesis An interactive tool provides a visual model by which students can work through Photosynthesis in the form of a game. http://www.pbs.org/wgbh/nova/nature/photosynthesis.html

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)

- ATP-ADP Model Presentation Students use their functional model of the ATP-ADP cycle (see possible instructional strategies above) to create a multimedia presentation or video that explains the cycle.

- Create a model of photosynthesis and respiration Students construct storyboards from the above activity to create a diagram or physical model of the process of photosynthesis, focusing on how the light-dependent and light-independent reactions transform light energy to chemical energy for photosynthesis, and the inputs and outputs of glycolysis, the Kreb's cycle, and electron transport chain for respiration. Optionally, students could show the connection between their models to demonstrate how photosynthesis and respiration are mirror processes.

- Testing for lipids, proteins, and carbohydrates lab Students can use the data collected from this lab (see possible instructional strategies above) as evidence to argue the claim that the sugars produced in photosynthesis interact with other elements to create amino acids, lipids, nucleic acids, and other large organic molecules. This resource is available from http://www.seplessons.org/node/362

- Fermentation in a bag In this freely available simple lab activity, students can choose different factors to test to see their effects on the process of fermentation in yeast cells. This resource is available from https://www.youtube.com/watch?v=4Eo7JtRA7lg&index=8&list=PLwL0Myd7Dk1F0iQPGrjehze3eDpco1eVz

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