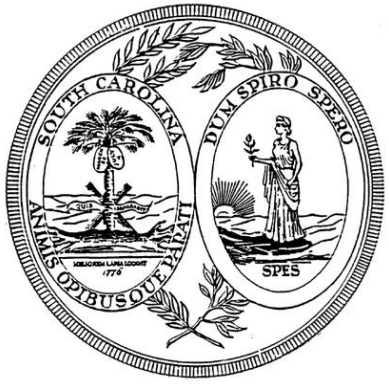
South Carolina Academic Standards and Performance Indicators for Science 2014



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
Life Science: Cells as a System
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.2 The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.

Conceptual Understanding
H.B.2A The essential functions of a cell involve chemical reactions that take place between many different types of molecules (including carbohydrates, lipids, proteins and nucleic acids) and are catalyzed by enzymes.
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.**

Carbohydrates	Organic Molecules	Steroids	Structural Proteins	Substrate
Lipids	Glycogen	Contractile Proteins	Transport Proteins	Catalyst
Proteins	Cellulose	Hormone Proteins	Activation Energy	
Nucleic Acids	Phospholipids	Enzymatic Proteins	Enzymes	

Performance Indicators **Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's.**
H.B.2A.1 *Construct explanations* of how the structures of carbohydrates, lipids, proteins, and nucleic acids (including DNA and RNA) are related to their functions in organisms. H.B.2A.2 *Plan and conduct investigations* to determine how various environmental factors (including temperature and pH) affect enzyme activity and the rate of biochemical reactions.

***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.6 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.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.

***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). *Enzymes use a lock and key method to bring reactants together to create chemical reactions.*

5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. *Carbohydrates, Lipids, and Proteins are used by the body to create energy with each having important characteristics that allowed them to be used in different ways.*

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

Prior Knowledge
● 7.P.2A.4 Ionic and Covalent Bonds; Chemical Formulas ● 7.L.4 DNA and Inheritance ● 7.P.2B.3 pH ● 7.P.2B.5 Chemical reactions
Subsequent Knowledge
● H.C.3A.6 Structure of common natural and synthetic polymers ● H.C.5A.4 Properties of acids, bases and salts ● H.C.6A.4 Predicting reactants and products in chemical reactions ● H.C.7A.3 Determining various effects on the rate of chemical reactions

Possible Instructional Strategies/Lessons **Strategies and lessons that will enable students to master the standard and/or indicator.**
● Create a concept map for organic molecules and their functions. An article describing concept map usage can be found here: http://cmap.ihmc.us/docs/theory-of-concept-maps ● Construct 2D paper models of carbohydrates, lipids, proteins, and nucleic acids. ● Conduct a calorimetry lab (wet or virtual) to compare the caloric values of carbohydrates, lipids, and proteins. A Sample Calorimetry Lab can be found here: http://www.biologyjunction.com/energy_in_food.htm ● Biology in Motion Mini Lecture: Enzyme Characteristics - This animation is a quick demonstration of the lock and key model of enzyme function. The animation can be found here: http://biologyinmotion.com/minilec/wrench.html ● Create Enzymes to show Lock and Key principle through cardstock cut outs. Cut out multiple shapes and sizes and give each student a piece. Then have students search around the room for the match for their piece.

Resources
• Amoeba Sisters: Biomolecules (updated). Video can be found here: https://www.youtube.com/watch?v=YO244P1e9QM • Crash Course Biology: Biological Molecules. Video can be found here: https://youtu.be/H8WJ2KENlK0 • Howard Hughes Medical Institute: Chemistry of Life. Resource can be found here: http://www.hhmi.org/biointeractive/chemistry-life • Amoeba Sisters: Enzymes and… Pac Man? Video can be found here: https://www.youtube.com/watch?v=YO244P1e9QM
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)**
• Enzyme Lab: This is an example of an enzyme lab where students test for the presence of catalase. The lab can be adapted to be inquiry based by giving students the procedure to test the activity of catalase then allowing them to choose various environmental factors (e.g. temperature & pH) to see how they affect the activity of the enzyme. The sample enzyme lab can be found here: https://www.biologycorner.com/worksheets/enzyme_lab.html

Unit Title
Life Science: Cells as a System
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.2 The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.

Conceptual Understanding
H.B.2B Organisms and their parts are made of cells. Cells are the structural units of life and have specialized substructures that carry out the essential functions of life. Viruses lack cellular organization and therefore cannot independently carry out all of the essential functions of 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.

Nucleus	Chromosome	Cytoskeleton	Endoplasmic Reticulum (ER)	Ribosomes
Golgi Complex	Vesicles	Prokaryotic Cells	Eukaryotic Cells	Mitochondria
Cell Wall	Central Vacuole	Chloroplasts	Chitin	Virus

Performance Indicators

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

H.B.2B.1 *Develop and use models* to explain how specialized structures within cells (including the nucleus, chromosomes, cytoskeleton, endoplasmic reticulum, ribosomes and Golgi complex) interact to produce, modify, and transport proteins. Models should compare and contrast how prokaryotic cells meet the same life needs as eukaryotic cells without similar structures.

H.B.2B.2 *Collect and interpret descriptive data* on cell structure to compare and contrast different types of cells (including prokaryotic versus eukaryotic, and animal versus plant versus fungal).

H.B.2B.3 *Obtain information to contrast* the structure of viruses with that of cells and to explain, in general, why viruses must use living cells to reproduce.

*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 and use models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.B.1A.6 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.B.1A.8 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.

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). *Models could be created to show the structures inside of a prokaryotic and eukaryotic cell and what their functions are in relation to the cell.*

6. Structure and Function: The National Research Council (2012) states that "The way in which an object or living thing is shaped and its substructure determine many of its properties and functions" (p. 84). *Each organelle has a function inside a Eukaryotic cell without that organelle functioning properly the cell is affected in some way.*

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

Prior Knowledge

- 6.L.4A.1 Characteristics of living organisms)=
- 6.L.4A.2 Cellular characteristics in Extended Knowledge
- 6.L.5B.2 Chloroplasts
- 7.L.3A.1 Cell theory
- 7.L.3A.2 Cell types
- 7.L.3A.3 Cell structure and function

Subsequent Knowledge

- N/A

Possible Instructional Strategies/Lessons

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

- Animal Cell Coloring and Description can be found here: https://www.biologycorner.com/worksheets/cellcolor.html
- Plant Cell Coloring and Description can be found here: https://www.biologycorner.com/worksheets/cell_color_plant.html
- Virtual Plant Lab: virtual version of a plant cell lab also available from this website can be found here: https://www.biologycorner.com/worksheets/plantcell-virtual.html
- Virtual Cheek Cell Lab: virtual version of an animal cell lab also available from this website can be found here: https://www.biologycorner.com/worksheets/cheekcell-virtual.html
- Create a Venn-diagram comparing prokaryotic and eukaryotic cells.
- Create a concept map of the various eukaryotic cell types (animal, plant, fungi). An article explaining how to use concept maps can be found here: http://cmap.ihmc.us/docs/theory-of-concept-maps
- Virus: Living or Nonliving- Break the class into three groups. Give one group the task of proving with facts that viruses are living organisms and give the other group the task of proving that viruses are nonliving. The third group is given the job of explaining and defending why a living/nonliving virus needs a living cell to reproduce. All arguments must be backed by research and cited during speaking (socratic seminar or a debate format)

Resources

- Amoeba Sisters: Prokaryotes and Eukaryotes Video can be found here: https://www.youtube.com/watch?v=ruBAHiij4EA&list=PLwL0Myd7Dk1HR9u5jw19E1_Q5u25PKg8v&index=1
- Crash Course Biology: Eukaryotes Video can be found here: https://youtu.be/cj8dDTHGJBY

- Howard Hughes Medical Institute: Biointeractive: Viruses Resources can be found here: http://www.hhmi.org/biointeractive/search?sort_by=created&redirect=1&field_biointeractive_topics%5B0%5D=26642

- Amoeba Sisters: Virus Replication and the Mysterious Common Cold Video can be found here: https://www.youtube.com/watch?v=PHp6iYDi9ko&list=PLwL0Myd7Dk1FFrTjLejW-YCkEO17D9TMd&index=1

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)

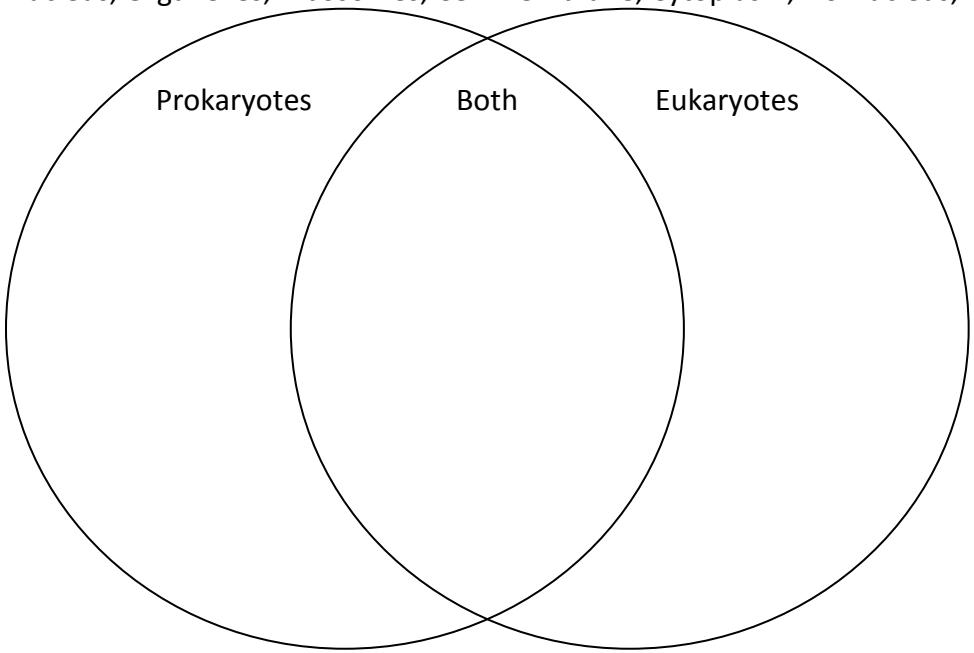
- Place each of the following terms into the correct column:

Animal cell, Plant cell, Bacteria cell, Fungal cell, Archaea cell.

Prokaryotes	Eukaryotes

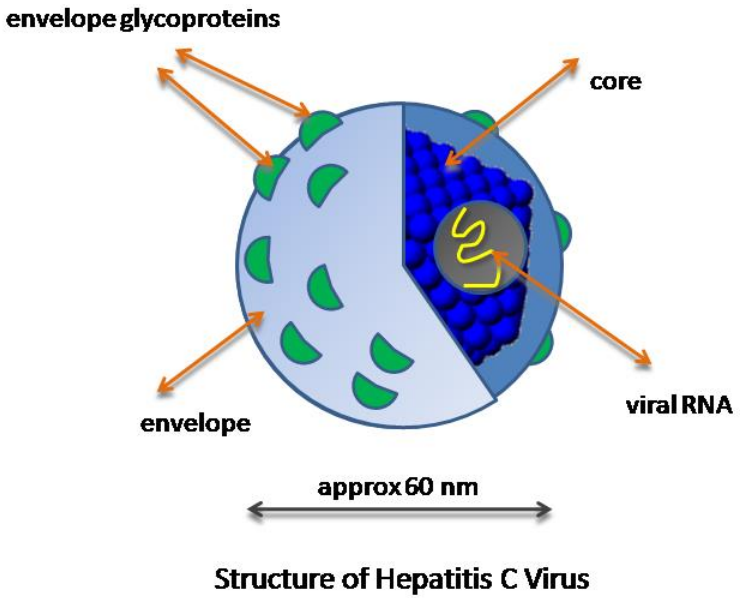
- Fill in the Venn Diagram using the following terms:

Nucleus, Organelles, Ribosomes, Cell Membrane, Cytoplasm, No Nucleus, No Organelles.



- Starting from a ribosome, identify the sequence of organelles a protein would travel through from when it is synthesized to when it is secreted from the cell. Explain what happens to the protein at each organelle.

The figure below is a diagram of a hepatitis C virus (Beards, 2008).



Structure of Hepatitis C Virus

- Compare the structure of this virus to a living cell, and explain why the virus must using living cells to reproduce.

Unit Title
Life Science: Cells as a System
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.2 The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.

Conceptual Understanding
H.B.2C Transport processes which move materials into and out of the cell serve to maintain homeostasis of the cell.

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.

Homeostasis	Cell Membrane	Semipermeable	Selectively Permeable	Passive Transport
Diffusion	Concentration Gradient	Facilitated Diffusion	Osmosis	Active Transport
Endocytosis	Exocytosis	Hypertonic Solution	Isotonic Solution	Hypertonic Solution

Performance Indicators

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

H.B.2C.1 *Develop and use models* to exemplify how the cell membrane serves to maintain homeostasis of the cell through both active and passive transport processes.

H.B.2C.2 *Ask scientific questions* to define the problems that organisms face in maintaining homeostasis within different environments (including water of varying solute concentrations).

H.B.2C.3 *Analyze and interpret data* to explain the movement of molecules (including water) across a membrane.

***Science and Engineering Practices**

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H.B.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.

H.B.1A.2 Develop and use 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.

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). *Through activities students model how membrane transportation occurs and the multiple forms that it can take.*

5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. *During transport, matter is moved across the cell membrane through multiple methods depending on the concentration on both sides and/or if energy is needed to transport the matter.*

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). *In many cases membrane transport is the cell's way of becoming isotonic or balanced where the concentration of matter is equal on both sides of the cell membrane. This gives the cell stability.*

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

Prior Knowledge

- 6.L.5B.1 Transport of food and water
- 7.L.3A.3 Cell structure and function

Subsequent Knowledge

- H.C.5A.1 Solutions, Concentration

Possible Instructional Strategies/Lessons

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

- Why does the color spread? Before starting the topic, have a beaker filled with water and add a couple drops of food coloring. Have students make observations and record what they believe is occurring and then discuss words like diffusion, concentration, and equilibrium.

- Cell Membrane Inquiry Activity Have students create a bubble membrane to test the ability of different size objects ability to move from one side of the membrane to the other. This resource can be found here: http://gamsp.wikispaces.com/file/view/Using+Bubbles+to+Explore+Membranes.doc Also see another version at http://www.clearbiology.com/cell-membrane-bubble-lab/

- Red Rover Red Rover! Have students play a game of Red Rover once they understand the different forms of transportation to further help them understand how matter travels across the cell membrane. Activity can be found here: https://www.teachengineering.org/activities/view/van_membrane_activity3

Resources

- Amoeba Sisters: Homeostasis (and the Cell Membrane King) Video can be found here: https://www.youtube.com/watch?v=6fhbbFd4icY&list=PLwL0Myd7Dk1HR9u5jw19E1_Q5u25PKg8v&index=2

- Amoeba Sisters: Cell Transport: Molecules Like to Move it, Move it Video can be found here: https://www.youtube.com/watch?v=Ptmlvtei8hw&list=PLwL0Myd7Dk1HR9u5jw19E1_Q5u25PKg8v&index=3

- Crash Course Biology: Membrane Transport Video can be found here: https://youtu.be/dPKvHrD1eS4

- Membrane Transport Red Rover Activity can be found here: https://www.teachengineering.org/activities/view/van_membrane_activity3

Sample Formative Assessment Tasks/Questions

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- Have students design a lab to test the effects of various liquids (e.g. various concentrations of salt/sugar water, soda, juice, distilled water, etc.) on the mass of representative cells (e.g. peeled grapes, shell-less eggs, or dialysis tubing). Then have students explain the results in terms of diffusion/osmosis. A sample egg osmosis lab can be found here: http://edtech2.boisestate.edu/pattymcginnis/592/Files/506%20Lesson%202%20Egg%20Osmosis%20Lab.pdf

Unit Title
Life Science: Cells as a System
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.2 The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.

Conceptual Understanding
H.B.2D The cells of multicellular organisms repeatedly divide to make more cells for growth and repair. During embryonic development, a single cell gives rise to a complex, multicellular organism through the processes of both cell division and differentiation.
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.**

Mitotic Cell Division	G1 Phase	Nuclear Membrane	Anaphase	Benign Tumor
Differentiation	S Phase	Centrosomes	Telophase	Malignant Tumor
Cell Cycle	G2 Phase	Spindle Fibers	Cleavage Furrow	Stem Cells
Mitosis	Mitotic Phase	Metaphase	Cell Plate	Plant Stem Cells
Cytokinesis	Daughter Cells	Sister Chromatids	Checkpoints	Adult Stem Cells

Interphase	Prophase	Centromere	Cancer Cells	Embryonic Stem Cells
Cell-based Regenerative Therapies				

Performance Indicators

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

H.B.2D.1 *Construct models* to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.

H.B.2D.2 *Develop and use models* to exemplify the changes that occur in a cell during the cell cycle (including changes in cell size, chromosomes, cell membrane/cell wall, and the number of cells produced) and predict, based on the models, what might happen to a cell that does not progress through the cycle correctly.

H.B.2D.3 *Construct explanations* for how the cell cycle is monitored by checkpoint systems and communicate possible consequences of the continued cycling of abnormal cells.

H.B.2D.4 *Construct scientific arguments* to support the pros and cons of biotechnical applications of stem cells using examples from both plants and animals.

***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 and use models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.B.1A.6 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.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). *During the cell cycle, cells go through checkpoints that either tell the cell to proceed to the next phase or stop. This is all dependent on a checklist of items that occur before proceeding.* 4. Systems and system 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). *Students model the phases of mitosis, chromosome movement, and the events that occur during mitosis.*

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

Prior Knowledge
● 6.L.4A.2 Unicellular and multicellular organisms in Extended Knowledge ● 7.L.3A.1 Cell theory – Mitosis and meiosis in Extended Knowledge ● 7.L.4A.5 Mutations ● 7.L.4A.6 Biotechnology in Extended Knowledge ● 7.L.3B.1 Levels of organization ● 7.L.3B.2 Human Body Systems in Extended Knowledge
Subsequent Knowledge
● N/A

Possible Instructional Strategies/Lessons **Strategies and lessons that will enable students to master the standard and/or indicator.**
● Becoming Mitosis To help students understand Mitosis, give students a piece of paper with a number on it and another student a piece of paper with the same number. Do this until all students have a number and a partner. Take the students outside and have them run through the phases of mitosis telling you what happens at each student. This can be further enhanced by adding in S phase and DNA replication and

showing students how they number doubles before entering into M phase. This same activity can be done for Meiosis as well, but students will have to exchange pieces of their paper to signify crossing over.

- Explaining STEM Therapy to a family member Have students work through a scenario where they must explain to a family member who is sick what STEM cell therapy is and what the pros and cons would be of the treatment based on research and facts. It must be explained in a way that a person not knowing anything about it would be able to make an informed decision on their options and whether to use the therapy.

- What would a cell do? Have students create models of the cell cycle; what causes a cell to move from one phase to the next, what occurs during that phase, and what they believe would happen if the cell if it did not complete that phase.

Resources

- Amoeba Sisters: The Cell Cycle and Cancer Video can be found here: https://www.youtube.com/watch?v=lpAa4TWjHQ4&list=PLwL0Myd7Dk1F1pp-DaLx3ygO_7xA-yyd4&index=2

- Amoeba Sisters: The Amazing Cell Process that Uses Division to Multiply! (Updated) Video can be found here: https://www.youtube.com/watch?v=f-ldPgEfAHI&list=PLwL0Myd7Dk1F1pp-DaLx3ygO_7xA-yyd4&index=3

- Crash Course Biology Mitosis Video can be found here: https://youtu.be/L0k-enzoeOM?list=PL3EED4C1D684D3ADF

- Howard Hughes Medical Institute: Biointeractive: Cell Growth and Division Resources can be found here: http://www.hhmi.org/biointeractive/search?sort_by=created&redirect=1&field_biointeractive_topics%5B0%5D=26678

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)

- Mitosis Gummy Worm Activity (There are many other versions of this lab that can be found for both Mitosis and Meiosis). Students use gummy worms to model the process of mitosis. The students can use their electronic devices to take pictures at each phase of the process

and insert them into a document that explains what is happening in each phase. A sample version of this activity can be found here: https://tripsanders.files.wordpress.com/2008/01/mitosis-cell-division-lab-0107.doc A video on this activity can be found here: https://www.youtube.com/watch?v=ICF8JfCNtp0

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