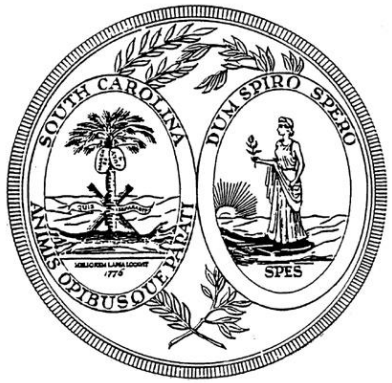
South Carolina Academic Standards and Performance Indicators for Science 2014



Instructional Units Resource

Chemistry

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

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

Chemistry Overview of Units

Unit 1		Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
ATOMIC STRUCTURE AND NUCLEAR PROCESSES		BONDING AND CHEMICAL FORMULAS	STATES OF MATTER	SOLUTIONS, ACIDS, AND BASES	CHEMICAL REACTIONS	THERMOCHEMISTRY AND CHEMICAL KINETICS
Standard		**Standard**	**Standard**	**Standard**	**Standard**	**Standard**
H.C.2		H.C.3	H.C.4	H.C.5	H.C.6	H.C.7
Conceptual Understanding		**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**
H.C.2A	H.C.2B	H.C.3A	H.C.4A	H.C.5A	H.C.6A	H.C.7A
Performance Indicators		**Performance Indicators**	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
H.C.2A.1 H.C.2A.2 H.C.2A.3	H.C.2B.1 H.C.2B.2 H.C.2B.3 H.C.2B.4	H.C.3A.1 H.C.3A.2 H.C.3A.3 H.C.3A.4 H.C.3A.5 H.C.3A.6 H.C.3A.7	H.C.4A.1 H.C.4A.2 H.C.4A.3	H.C.5A.1 H.C.5A.2 H.C.5A.3 H.C.5A.4	H.C.6A.1 H.C.6A.2 H.C.6A.3 H.C.6A.4	H.C.7A.1 H.C.7A.2 H.C.7A.3 H.C.7A.4
***Science and Engineering Practices**		***Science and Engineering Practices**	***Science and Engineering Practices**	***Science and Engineering Practices**	***Science and Engineering Practices**	***Science and Engineering Practices**
S.1A.2 S.1A.6 S.1A.4 S.1A.8 S.1A.5		S.1A.2 S.1A.6 S.1A.3 S.1A.4	S.1A.2 S.1A.3 S.1A.4	S.1A.4 S.1A.5 S.1A.8	S.1A.2 S.1A.3 S.1A.5	S.1A.2 S.1A.5 S.1A.3 S.1A.4
***Crosscutting Concepts**		***Crosscutting Concepts**	***Crosscutting Concepts**	***Crosscutting Concepts**	***Crosscutting Concepts**	***Crosscutting Concepts**
1, 2, 3, 4, 5, 6, 7		1, 4, 6	2, 4, 5	2, 3, 6	1, 2, 3, 4, 7	2, 3, 4, 6, 7

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

Unit Title
Chemistry: Bonding and Chemical Formulas
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.C.3 The student will demonstrate an understanding of the structures and classification of chemical compounds.

Conceptual Understanding
H.C.3A Elements are made up of only one kind of atom. With increasing atomic number, a predictable pattern for the addition of electrons exists. This pattern is the basis for the arrangement of elements in the periodic table. The chemical properties of an element are determined by an element's electron configuration. Elements can react to form chemical compounds/molecules that have unique properties determined by the kinds of atoms combined to make up the compound/molecule. Essentially, the ways in which electrons are involved in bonds determines whether ionic or covalent bonds are formed. Compounds have characteristic shapes that are determined by the type and number of bonds formed.
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.**

Valence Electrons	Covalent Bond	Ionic Bond	Ionic Compounds	Molecular Compounds
Single Chain Alkanes	Linear Geometry	Bent Geometry	Trigonal Planar Geometry	Trigonal Pyramidal Geometry
Tetrahedral Geometry	Polyatomic ions	Polar Covalent Bond	Nonpolar Covalent Bond	Electronegativity
Hydrocarbons	Hybridization	Isomers	Polymer	Monomer
Empirical Formula	Molecular Formula	Percent Composition		

Performance Indicators

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

H.C.3A.1 *Construct explanations* for the formation of molecular compounds via sharing of electrons and for the formation of ionic compounds via transfer of electrons.

H.C.3A.2 Use the periodic table to write and *interpret* the formulas and names of chemical compounds (including binary ionic compounds, binary covalent compounds, and straight-chain alkanes up to six carbons).

H.C.3A.3 *Analyze and interpret data* to predict the type of bonding (ionic or covalent) and the shape of simple compounds by using the Lewis dot structures and oxidation numbers.

H.C.3A.4 *Plan and conduct controlled scientific investigations* to generate data on the properties of substances and analyze the data to infer the types of bonds (including ionic, polar covalent, and nonpolar covalent) in simple compounds.

H.C.3A.5 *Develop and use models* (such as Lewis dot structures, structural formulas, or ball-and-stick models) of simple hydrocarbons to exemplify structural isomerism.

H.C.3A.6 *Construct explanations* of how the basic structure of common natural and synthetic polymers is related to their bulk properties.

H.C.3A.7 *Analyze and interpret data* to determine the empirical formula of a compound and the percent composition of a compound.

*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.C.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.C.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.C.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.C.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.

***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). *The anion in a binary ionic compound ends in -ide.*

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). *Lewis dot diagrams model the placement of valence electrons.*

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). *Nonmetals have outer energy levels containing four, five, six, and seven valence electrons. Metals have outer energy levels containing one, two, and three valence electrons. These outer energy levels determine what kind of bonds can be formed.*

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

Prior Knowledge

- 7.P.2A.4 Ionic and Covalent Bonding, Chemical Formulas
- 7.P.2B.1 Physical and Chemical Properties
- 7.P.2B.4 Physical and Chemical Changes

Subsequent Knowledge

- N/A

Possible Instructional Strategies/Lessons

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

- Chemical Bonds This simulation allows students to construct explanations the creation of covalent and ionic bonds. This resource is available from https://concord.org/stem-resources/chemical-bonds

- Ionic and Covalent Bonding Lab Students can plan and conduct an investigation to generate data on the properties of substances and analyze the data to infer the types of bonds (including ionic, polar covalent, and nonpolar covalent) in simple compounds. This can be structured as a guided inquiry lab or a step-by-step lab. An internet search can provide step-by-step labs already constructed.

- Using Properties to Identify Ionic and Molecular Compounds Students will plan and conduct investigations to generate data concerning the properties of substances and the type of bonds they have. Students will use the periodic table to assist in writing and interpreting chemical compounds. This activity is available at http://serc.carleton.edu/sp/mnstep/activities/35539.html

- The Chemistry Name Game Students will interpret formulas and names of chemical compounds in this game. This game has Lewis dot diagrams on the cards. This game is available at https://www.acs.org/content/dam/acsorg/education/outreach/kidschemistry/the-chemistry-name-game.pdf

- Candy Compounds Students make candy models to help them construct explanations for molecular compounds sharing electrons and ionic compounds transferring electrons. This activity can be found at http://sciencespot.net/Media/candycompounds.pdf

- Loopy Lewis Dot Diagrams This activity provides the rules for Lewis dot structures so students will be able to predict the type of bond and shape of the compound. This activity is available at http://serc.carleton.edu/sp/mnstep/activities/19777.html

- Percentage Composition and Empirical Formula Race Students will be able to analyze the empirical formula of different compounds in the race. This activity is available at http://www.chemteach.ac.nz/

- Bubble Gum: Calculating Percent Sugar Students will be able to interpret data to assist them with calculating the percent sugar in chewing gum. This is available at https://www.westminster.edu/about/community/sim/pdf/sbubblegumcalculatingpercentsugar.pdf

- Molecule Shapes: Interactive simulation that allows students to build three dimensional molecules and make observations on how molecular geometry changes with the addition of bonds and lone pairs of electrons. Teacher constructed lessons can be found in the "For Teachers" section. This is available at Natural and Synthetic Polymers: Students will be able to construct explanations of how the polymers are related to their properties. These activities are found at https://www.stem.org.uk/elibrary/list/134825/natural-and-synthetic-polymers

- Shapes of Molecules Lab in which students use molecular models to determine the geometry of covalent compounds. Students make

models of molecules such as water, sulfite, carbon tetrachloride and other common molecules. This resource is available at https://www.teachchemistry.org/content/aact/en/classroom-resources/high-school/molecules-and-bonding/vsepr-theory/shapes-of-molecules.html

- Structural Isomers Provide students with molecular model kits. Give them the formula for heptane (C_7H_{14}). Have students use the models to try and form all nine isomers of heptane and record their structures.

- Natural and Synthetic Polymers Students will be able to construct explanations of how the polymers are related to their properties. These activities are found at https://www.stem.org.uk/elibrary/list/134825/natural-and-synthetic-polymers

- Polymer Lab Have students make a polymer using Borax and glue, or polyvinyl alcohol. Have them design and conduct experiments to determine the properties of their polymer. An internet search will provide a list of possible activities and recipes for creating polymers.

Resources

- Chemical Bonds Interactive Students use the interactive to construct explanations for molecular compounds sharing electrons and ionic compounds transferring electrons. This interactive is found at http://www.pbslearningmedia.org/resource/lsps07.sci.phys.matter.chembonds/chemical-bonds/

- Percent Composition, Empirical and Molecular Formulas: This resource will help students interpret data to determine empirical formulas and percent composition. This resource is available at http://www.sciencegeek.net/Chemistry/Presentations/PercentComposition/

- Polymers-Crash Course Chemistry #45: This video explains what polymers are and how they are formed. This resource is available at https://www.youtube.com/watch?v=rHxxLYzJ8Sw

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)

- Structural Isomers Provide students with molecular model kits. Give them the formula for hexane (C_6H_{12}) and have them use the models to figure out and record all five structural isomers.

- Whiteboards - Students can use whiteboards to illustrate Lewis dot structures, identify compounds as ionic or covalent, to write compound formulas and names, and to show calculations for percent composition and empirical formulas.

- Exit Slips:
  - Explain the difference in polar and nonpolar covalent bonds in terms of electron arrangement.
  - Why do ionic and polar covalent substances dissolve in water but nonpolar covalent substances do not?
  - Explain the phrase “Like dissolves like” in terms of solubility of substances.
  - Have students draw all of the structural isomers for a particular organic compound.

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