Shelby County Schools Science Vision

Shelby County Schools' vision of science education is to ensure that from early childhood to the end of the 12th grade, all students have heightened curiosity and an increased wonder of science; possess sufficient knowledge of science and engineering to engage in discussions; are able to learn and apply scientific and technological information in their everyday lives; and have the skills such as critical thinking, problem solving, and communication to enter careers of their choice, while having access to connections to science, engineering, and technology.

To achieve this, Shelby County Schools has employed The Tennessee Academic Standards for Science to craft meaningful curricula that is innovative and provide a myriad of learning opportunities that extend beyond mastery of basic scientific principles.

Introduction

In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we must collectively work to provide our students with high quality standards aligned instruction. The Tennessee Academic Standards for Science provide a common set of expectations for what students will know and be able to do at the end of each grade, can be located in the Tennessee Science Standards Reference. Tennessee Academic Standards for Science are rooted in the knowledge and skills that students need to succeed in post-secondary study or careers. While the academic standards establish desired learning outcomes, the curricula provides instructional planning designed to help students reach these outcomes. The curriculum maps contain components to ensure that instruction focuses students toward college and career readiness. Educators will use this guide and the standards as a roadmap for curriculum and instruction. The sequence of learning is strategically positioned so that necessary foundational skills are spiraled in order to facilitate student mastery of the standards.

Our collective goal is to ensure our students graduate ready for college and career. Being College and Career Ready entails, many aspects of teaching and learning. We want our students to apply their scientific learning in the classroom and beyond. These valuable experiences include students being facilitators of their own learning through problem solving and thinking critically. The Science and Engineering Practices are valuable tools used by students to engage in understanding how scientific knowledge develops. These practices rest on important "processes and proficiencies" with longstanding importance in science education. The science maps contain components to ensure that instruction focuses students toward understanding how science and engineering can contribute to meeting many of the major challenges that confront society today. The maps are centered around five basic components: the Tennessee Academic Standards for Science, Science and Engineering Practices, Disciplinary Core Ideas, Crosscutting Concepts, and Phenomena.

The Tennessee Academic Standards for Science were developed using the National Research Council's 2012 publication, A Framework for K-12 Science Education as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science classrooms. Thinking about science had become memorizing concepts and solving mathematical formulae. Practicing science had become prescribed lab situations with predetermined outcomes. The framework proposes a three-dimensional approach to science education that capitalizes on a child's natural curiosity. The Science Framework for K-12 Science Education provides the blueprint for developing the effective science practices. The *Framework* expresses a vision in science education that requires students to operate at the nexus of three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The *Framework* identified a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve. Key to the vision expressed in the *Framework* is for students to learn these disciplinary core ideas in the context of science and engineering practices. The importance of combining Science and Engineering Practices, Crosscutting Concepts and Disciplinary

Core Ideas is stated in the *Framework* as follows:

Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content. (NRC Framework, 2012, p. 218)

To develop the skills and dispositions to use scientific and engineering practices needed to further their learning and to solve problems, students need to experience instruction in which they use multiple practices in developing a particular core idea and apply each practice in the context of multiple core ideas. We use the term "practices" instead of a term such as "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Students in grades K-12 should engage in all eight practices over each grade band**.** Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. There are seven crosscutting concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world.

The map is meant to support effective planning and instruction to rigorous standards. It is *not* meant to replace teacher planning, prescribe pacing or instructional practice. In fact, our goal is not to merely "cover the curriculum," but rather to "uncover" it by developing students' deep understanding of the content and mastery of the standards. Teachers who are knowledgeable about and intentionally align the learning target (standards and objectives), topic, text(s), task, and needs (and assessment) of the learners are best-positioned to make decisions about how to support student learning toward such mastery. Teachers are therefore expected--with the support of their colleagues, coaches, leaders, and other support providers--to exercise their professional judgment aligned to our shared vision of effective instruction, the Teacher Effectiveness Measure (TEM) and related best practices. However, while the framework allows for flexibility and encourages each teacher/teacher team to make it their own, our expectations for student learning are non-negotiable. We must ensure all of our children have access to rigor—high-quality teaching and learning to grade level specific standards, including purposeful support of literacy and language learning across the content areas.

Science and Engineering Practices

1. Asking questions & defining problems
2. Developing & using models
3. Planning & carrying out investigations
4. Analyzing & interpreting data
5. Using mathematics & computational thinking
6. Constructing explanations & designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, & communicating information

Disciplinary Core Ideas

Physical Science
PS 1: Matter & its interactions
PS 2: Motion & stability: Forces & interactions
PS 3: Energy
PS 4: Waves & their applications in technologies for information transfer

Life Sciences
LS 1: From molecules to organisms: structures & processes
LS 2: Ecosystems: Interactions, energy, & dynamics
LS 3: Heredity: Inheritance & variation of traits
LS 4: Biological evaluation: Unity & diversity

Earth & Space Sciences
ESS 1: Earth's place in the universe
ESS 2: Earth's systems
ESS 3: Earth & human activity

Engineering, Technology, & the Application of Science
ETS 1: Engineering design
ETS 2: Links among engineering, technology, science, & society

Crosscutting Concepts

1. Patterns
2. Cause & effect
3. Scale, proportion, & quantity
4. Systems & system models
5. Energy & matter
6. Structure & function
7. Stability & change

Learning Progression

At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain phenomena. Students can keep notebooks to record sequential observations and identify simple patterns. They are able to design and conduct investigations, analyze results, and communicate the results to others. Students will carry their curiosity, interest and enjoyment of the scientific world view, scientific inquiry, and the scientific enterprise into middle school.

At the end of the middle school science experience, students can discover relationships by making observations and by the systematic gathering of data. They can identify relevant evidence and valid arguments. Their focus has shifted from the general to the specific and from the simple to the complex. They use scientific information to make wise decision related to conservation of the natural world. They recognize that there are both negative and positive implications to new technologies.

As an SCS graduate, former students should be literate in science, understand key science ideas, aware that science and technology are interdependent human enterprises with strengths and limitations, familiar with the natural world and recognizes both its diversity and unity, and able to apply scientific knowledge and ways of thinking for individual and social purposes.

Structure of the Standards

- Grade Level/Course Overview: An overview that describes that specific content and themes for each grade level or high school course.
- Disciplinary Core Idea: Scientific and foundational ideas that permeate all grades and connect common themes that bridge scientific disciplines.
- Standard: Statements of what students can do to demonstrate knowledge of the conceptual understanding. Each performance indicator includes a specific science and engineering practice paired with the content knowledge and skills that students should demonstrate to meet the grade level or high school course standards.

Purpose of Science Curriculum Maps

This map is a guide to help teachers and their support providers (e.g., coaches, leaders) on their path to effective, college and career ready (CCR) aligned instruction and our pursuit of Destination 2025. It is a resource for organizing instruction around the Tennessee Academic Standards for Science, which define what to teach and what students need to learn at each grade level. The map is designed to reinforce the grade/course-specific standards and content (scope) and provides *suggested* sequencing, pacing, time frames, and aligned resources. Our hope is that by curating and organizing a variety of standards-aligned resources, teachers will be able to spend less time wondering what to teach and searching for quality materials (though they may both select from and/or supplement those included here) and have more time to plan, teach, assess, and reflect with colleagues to continuously improve practice and best meet the needs of their students.

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Chemistry Quarter 1 Curriculum Map Curriculum Map Feedback Survey					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	6 weeks	9 weeks

WEEK 1: STRUCTURES AND ROUTINES

This week is for teachers to establish routines and procedures during the first week of school. No content is to be taught during this week.

(WEEKS 2-5) UNIT 1 Atomic Structure [4 Weeks]

Overarching Question(s)

How do particles combine to form the variety of matter one observes?

Unit	Lesson Length	Essential Questions	Vocabulary
Unit 1 Atomic Structure	**UNIT 1 = 4 WEEKS TOTAL WEEKS 2 - 5**	• What role does chemistry play in the world around us? • How does qualitative data differ from quantitative data? • What models of the atom have led to the development of our current understanding of atomic structure? • How do various atomic models compare with current scientific evidence? • How do models in science change over time?	Chemistry, substance, mass, weight, model, scientific method, qualitative data, quantitative data, hypothesis, experiment, independent variable, dependent variable, control, conclusion, theory, scientific law, pure research, applied research, Dalton's atomic theory, atom, cathode ray, electron, nucleus, proton, neutron

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.11** Develop and compare historical models of the atom (from Democritus to quantum model) and construct arguments to show how scientific knowledge evolves over	**Learning Outcomes** • Familiarity with use and importance of the scientific method, including hypothesis, independent/dependent variables • Differentiation between a theory and a scientific law • Compare and contrast the major models of the atom (i.e. Bohr, and the quantum mechanical model).	**Curricular Resources** **Engage** • Ch. 3 Section 1 Classroom Catalyst, TE pg. 69 • Ch. 3 Section 2 Classroom Catalyst, TE pg. 74 • Differentiated Instruction TE pg. 70 • Quick Lab: Constructing a Model, TE/SE pg. 73 • Demo: Cathode-Ray Tube, TE/SE pg. 75 • Ch. 4 Section 1 Classroom Catalyst, TE pg. 97

time, based on experimental evidence, critique, and alternative interpretations. ***This standard should be taught in conjunction with and to support other standards within this unit.** Science standards reference guide https://www.tn.gov/content/dam/tn/education/standards/sci/sci_standards_reference.pdf **Explanation** As students have developed an understanding of physical science concepts leading to chemistry, they have implemented a number of these models; however, the names have not been made explicit. One approach which may be taken to this standard is to incorporate the ideas when appropriate to other standards. For example, Thomson's model is sufficient for bond classifications and nomenclature when differentiating between ionic and molecular compounds. **Misconceptions** • Atoms are round solid sphere containing no smaller particles. • Emphasize that the identity of the atom is determined by the number of protons, not the number of electrons or neutrons. The numbers of electrons and neutrons can each vary and the atom will still be of the same element. But if the number of protons changes	• Identify the contributions of major atomic theorists: Bohr, Chadwick, Dalton, Planck, Rutherford, and Thomson. • Compare the Bohr model and the quantum mechanical electron-cloud models of the atom. **Phenomenon** Use of the scientific method in research and development for all scientific research such as drug development. Introduce students to the steps of scientific research used from the beginning to the end of drug development. Have students consider a familiar example of a weighted average. For example, a students' grade where each category is counted a different percentage. Discuss the process of calculating their grade. Take this same concept and apply it to the calculation of average atomic mass as seen on the periodic table.	**Interactive Video** • Modern Chemistry Web Resources: Atomic Theory & Structure • Modern Chemistry Web Resources: History of Atom and Hydrogen & Helium: Atomic Theory I: Cathode Rays, Electrons and the Nucleus • Atomic Theory II: Bohr and the Beginnings of Quantum Theory • Rutherford Scattering **Explore** **Laboratory Activities/Investigations** • Modern Chemistry p. 73 Quick Lab • Phet labs to accompany PhET simulations **Explain** **Articles** • History of Chemistry **Elaborate** • Careers in Chemistry: Nanotechnologist pg. 72 • Modern Chemistry Science Standards Guide: PS1.11: Models of the Atom **Evaluate** • Ch. 3 Section 1 Formative Assessment, TE/SE pg. 73 • Ch. 3 Study Guide • Alternative Assessment, TE pg. 77 • Ch. 3 Section 2 Formative Assessment, TE/SE pg. 78 • Ch. 4 Section 1 Formative Assessment, TE/SE pg. 103 • Alternative Assessment, TE pg. 107 • Ch. 4 Section 2 Formative Assessment, TE/SE pg. 110

then the atom becomes an atom of a different element. ***Science and Engineering Practice*** **Engaging in argument from evidence** Students critically evaluate evidence supporting an argument and create written or oral arguments which invoke empirical evidence, scientific reasoning and scientific explanations. **Cross Cutting Concepts** **Systems and System Models** Students create and manipulate a variety of different models: physical, mathematical, and computational.		**Textbook** HMH Modern Chemistry, Chapter 3, pgs. 68-78 HMH Modern Chemistry, Chapter 4, pgs. 97-110 **Performance Tasks** Model Building Interaction: http://phet.colorado.edu/en/simulation/build-an-atom Build an atomic theory timeline using textbook resources and online resources. Students will use a piece of copy paper and markers or colored pencils to develop a timeline from Democritus to the Quantum atomic theory. Students should be given various elements and their atomic mass and atomic number. Students should then calculate the number of protons, neutrons, and electrons. Students should also identify and calculate the atomic number and atomic mass when given the number of protons, neutrons, and electrons.

Chemistry Quarter 1 Curriculum Map					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks

Unit 1 Atomic Structure (2 Weeks)			
Overarching Question(s)			
How are waves used to transfer energy and information?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**2 weeks**	How are calculations impacted by the accuracy of measuring devices and the precision of the measurements? How do scientist's express quantities and convert them into different units?	Base unit, second, meter, amplitude, atomic emission spectrum, frequency, photoelectric effect, photon, Planck's constant, quantum, wavelength

Standards and Related Background Information	**Instructional Focus**	**Instructional Resources**
DCI **CHEM1.PS4:** Waves and Their Applications in Technologies for Information Transfer **Standard** **CHEM1.PS4.1** Using a model, explain why elements emit characteristic frequencies of light and how this information is used **Explanation** An understanding of the behavior of light as has been developed first by investigating properties of waves in fourth grade and more recently in	**Learning Outcomes** Use SI system during measurement and problem solving. Use a variety of appropriate notations (e.g., exponential, functional, square root). Accuracy, precision, and error in a series of measurements. Read/interpret graphs: (pie, bar, and line) Interpret a Bohr model of an electron moving between its ground and excited states in terms of the absorption or emission of energy. **Phenomenon** Why does glow in the dark paint glow? Why do fireworks explode in various colors?	**Curricular Resources** 5E Lesson Resource Link **Textbook** Modern Chemistry Chap. 3 Sec. 3 Modern Chemistry Chap. 4 **Laboratory Activities/Investigations** Flame test lab or demonstration Modern Chemistry Teacher Resources PhET labs based on simulations found at https://colorado.edu/en/simulations/category/new

eighth grade when students differentiated between mechanical and electromagnetic waves. This is the first time that students investigate a mechanism for the emission of photons. Emphasis should be placed on the emission of characteristic colors of light emitted when electrons undergo specific movements and unique spectra of each element that result. Students should explore the implications of these ideas on astronomy. (Clarification may be needed to differentiate this particulate behavior of light from previous discussions of its wave properties; however, discussions of Quantum Theory in differentiating wave-particle duality are beyond the scope of this standard). **Misconceptions** Atoms naturally emit light if they contain energy the emission of light has nothing to do with gaining energy from an outside source. **Science and Engineering Practice** **Developing and using models** Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system. **Cross Cutting Concepts** **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.	Help students understand the process of paint particles gaining energy from light and glowing as the excited electrons move from the excited state to the ground state. Use a flame test lab to help students see the colors emitted from different metallic ions as they gain energy from the flame and remit it as the electrons move from the ground state to the excited state and them back to the ground state. Link this lab activity to the different colors we see as fireworks explode.	**Simulations** Modern Chemistry Teacher Resources https://phet.colorado.edu/en/simulation/wave-on-a-string https://phet.colorado.edu/en/simulation/legacy/photoelectric https://phet.colorado.edu/en/simulation/legacy/discharge-lamps https://phet.colorado.edu/en/simulation/molecules-and-light https://phet.colorado.edu/en/simulation//legacy/hydrogen-atom Modern Chemistry Teacher Resources: Energy Levels of an Atom (Animation) **Videos** **Modern Chemistry Web Resources:** http://winter.group.shef.ac.uk/orbitron/ (shapes of orbitals) **Articles** Modern Chemistry p.114 The Noble Decade **https://www.ck12.org/c/chemistry/photoelectric-effect/lesson/Photoelectric-Effect-CHEM/?referrer=concept_detail** **Performance Tasks:** Have two students hold a coiled spring or slinky along the floor or a tabletop. Ask one of the students to begin moving the spring back and forth so that a wave pattern forms. Students should describe how the wavelength changes as the frequency of the movement is increased and then decreased. Students should draw a wave model and identify the trough, crest, wavelength, amplitude and frequency. This can then be related to the wavelength of light and then electrons in the atomic model.

		Students will observe gas tube or flame test colors of metals compounds using diffraction gratings or a simulation. Students will discuss why different metal compounds emit different colors. Students should then relate and discuss the relationship to the excitement of electrons and loss of energy as the atoms returning to the ground state which releases energy that relates to a specific wavelength of light in the visible spectrum. Paint a piece of poster board with glow in the dark paint. Turn of the lights in the classroom if it can be made dark by doing so. Expose the board to a camera flash while a student holds their hand in front of the board. The students should see that the paint glows where the flash hit the board but does not where the hand was held during the flash. Use this to lead the students to a discussion of electrons moving from the ground state to the excited state and then back to the ground state. Encourage students to use the terms ground state, excited state, and energy levels. Use this to lead into the photoelectric effect. Students will write orbital notations for various elements from the periodic table. Students will apply this concept to the organization of the periodic table. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

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Interactions of Matter
Part I</td><td colspan="2">Unit 3
Interactions of Matter
Part II</td><td>Unit 4
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<tr><td>Unit 2
Interactions of Matter
Part I</td><td>1 week</td><td colspan="3"><u>Essential Questions</u>
How is the position and energy of a specific electron assigned for an atom?
How is the charge on anions and cations determined by electron configurations?
How does the structure of matter determine its chemical and physical properties?
How does the structure of the periodic table allow us to predict the chemical and physical properties of an element?
How is the periodic table a template of organization for the material world?</td><td colspan="2">Periodic law, periodic table, lanthanide, actinide, alkali metals, alkaline earth metals, periodicity, Mendeleev, Moseley, transition elements, main-group elements, halogens, atomic radius, ion, ionization, ionization energy, electron affinity, cation, anion, valence electron, electronegativity</td></tr>
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DCI	**Learning Outcomes**	**Curricular Resources**
CHEM1.PS1: Matter and Its Interactions **Standard** **CHEM1.PS1.12** Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location of the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e. arrows representing electrons in an orbital). **Explanation** The concepts addressed in this standard appear as patterns leading to the arrangement of the periodic table or are patterns in the behavior of atom which can be explained by patterns within the periodic table. Students should engage in activities that provide opportunities to uncover these patterns. For example, an appropriate discussion of orbital notations would relate back to the organization of the periodic table, rather than merely following a chart simplifying the aufbau principle. Patterns for reactivity can be uncovered through investigation.	• Interpret the periodic table to describe an element's atomic makeup. • Apply the periodic table to determine the number of protons and electrons in a neutral atom. • Distinguish between the subatomic particles in terms of relative charge and mass. • Describe the structure of the atom, including the locations of the subatomic particles. • Calculate the number of electrons, protons, and neutrons in an atom, given its mass number and atomic number. • Draw Bohr models of the first 18 elements. • Identify the *s*, *p*, *d*, and *f* blocks based on their electron configuration and location on the periodic table. • Represent an electron's location in the quantum mechanical model of an atom in terms of the shape of electron clouds (s and p orbitals in particular), relative energies of orbitals, and the number of electrons possible in the s, p, d, and f orbitals. (Heisenberg Uncertainty Principle) • Use the periodic table to identify an element as a metal, nonmetal, or metalloid • Apply the periodic table to determine the number of protons and electrons in a neutral atom • Define and calculate an isotope. • Determine the number of protons and neutrons for a particular isotope of an atom • Determine the Lewis electron dot structure or number of valence electron from an atom of any main-group element from its atomic number or position in the periodic table. **Phenomenon**	5E Lesson Resource Link **Textbook** Modern Chemistry Chap. 5 **Laboratory Activities/Investigations** Modern Chemistry Quick Lab p. 134 Designing Your Own Periodic Table Labs accompanying PhET simulations https://phet.colorado.edu/en/simulations/category/chemistry **Simulations** Modern Chemistry Chap. 5 Teacher Resources: Animated Chemistry: Periodic Trends https://phet.colorado.edu/en/simulation/build-an-atom https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass http://phet.colorado.edu/en/simulation/hydrogen-atom **Video** Modern Chemistry: Why It Matters Video: Periodic Law **Articles** **https://www.ck12.org/c/chemistry/early-history-of-the-periodic-table/rwa/Finding-Patterns-in-Elemental-Behavior/?referrer=concept_details** Modern Chemistry Chap. 5 p. 143 Material Scientists Modern Chemistry Chap. 5 169A The Pieces Everything is Made of: A Table for Putting Small Pieces in Order **Performance Tasks**

Misconceptions There is no pattern to the organization of the periodic table. **Science and Engineering Practice** **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion. **Cross Cutting Concepts** **Patterns** Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations.	Relate the trends of the periodic table to trends in fashion and trends among teenagers. Students understand trends in fashion as things that everyone is doing. Relate the ideas of trends in society to the repetition of characteristics within groups and periods in the periodic table.	Modern Chemistry Web Resources: http://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass Electron Configuration Battleship – Divide into pairs, each student has a laminated Periodic Table (or one in a sheet protector) and dry erase marker. They mark out their 4 "ships" on the table (3, 4, or 5 elements in a row) with a dry erase marker. Without looking at their partner's board, students guess the location of the ships by using the electron configuration for the corresponding element location. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map			
Quarter 1	Quarter 2	Quarter 3	Quarter 4

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Unit 1 Atomic Structures (1 Week)			
Overarching Question(s)			
How are waves used to transfer energy and information?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**1 week**	**Essential Questions** What role does chemistry play in the world around us? How does qualitative data differ from quantitative data? What models of the atom have led to the development of our current understanding of atomic structure? How do various atomic models compare with current scientific evidence? How do models in science change over time?	Chemistry, substance, mass, weight, model, scientific method, qualitative data, quantitative data, hypothesis, experiment, independent variable, dependent variable, control, conclusion, theory, scientific law, pure research, applied research, Dalton's atomic theory, atom, cathode ray, electron, nucleus, proton, neutron
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**

DCI	Learning Outcomes	Curricular Materials
DCI **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.11** Develop and compare historical models of the atom (from Democritus to quantum model) and construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations. **This standard should be taught in conjunction with and to support other standards within this unit.* Science standards reference guide https://www.tn.gov/content/dam/tn/education/standards/sci/sci_standards_reference.pdf **Explanation** As students have developed an understanding of physical science concepts leading to chemistry, they have implemented a number of these models; however, the names have not been made explicit. One approach which may be taken to this standard is to incorporate the ideas when appropriate to other standards. For example, Thomson's model is sufficient for bond classifications and nomenclature when differentiating between ionic and molecular compounds. **Misconceptions** Atoms are round solid sphere containing no smaller particles.	**Learning Outcomes** Familiarity with use and importance of the scientific method, including hypothesis, independent/dependent variables Differentiation between a theory and a scientific law Compare and contrast the major models of the atom (i.e. Bohr, and the quantum mechanical model). Identify the contributions of major atomic theorists: Bohr, Chadwick, Dalton, Planck, Rutherford, and Thomson. Compare the Bohr model and the quantum mechanical electron-cloud models of the atom. **Phenomenon** Use of the scientific method in research and development for all scientific research such as drug development. Introduce students to the steps of scientific research used from the beginning to the end of drug development. Have students consider a familiar example of a weighted average. For example, a students' grade where each category is counted a different percentage. Discuss the process of calculating their grade. Take this same concept and apply it to the calculation of average atomic mass as seen on the periodic table.	**Curricular Materials** 5E Lesson Resource Link **Textbook** Modern Chemistry Ch. 3 & 4 Interactive Video Modern Chemistry Web Resources: http://www.visionlearning.com/library/module_viewer.php?mid=49&l **Laboratory Activities/Investigations** Modern Chemistry p. 73 Quick Lab Phet labs to accompany PhET simulations https://colorado.edu/en/simulations/category/new **Simulations** Modern Chemistry Web Resources: History of Atom and Hydrogen & Helium: http://www.visionlearning.com/library/module_viewer.php?mid=50 Ions, atoms, molecules simulation: http://www.visionlearning.com/library/module_viewer.php?mid=51 https://phet.colorado.edu/en/simulation/rutherford-scattering **Articles** **https://www.ck12.org/c/chemistry/history-of-chemistry/lesson/Events-in-Chemistry-History-CHEM/?referrer=concept_details** Modern Chemistry p. 72 Nanotechnologist **Performance Tasks** Modern Chemistry Web Resources: Tutorial http://www.teachersdomain.org/asset/lsps07_int_theatom/ Model Building Interaction:

<u>Science and Engineering Practice</u> **Engaging in argument from evidence** Students critically evaluate evidence supporting an argument and create written or oral arguments which invoke empirical evidence, scientific reasoning and scientific explanations. **<u>Cross Cutting Concepts</u>** **Systems and System Models** Students create and manipulate a variety of different models: physical, mathematical, and computational.		http://phet.colorado.edu/en/simulation/build-an-atom Build an atomic theory timeline using textbook resources and online resources. Students will use a piece of copy paper and markers or colored pencils to develop a timeline from Democritus to the Quantum atomic theory. Students should be given various elements and their atomic mass and atomic number. Students should then calculate the number of protons, neutrons, and electrons. Students should also identify and calculate the atomic number and atomic mass when given the number of protons, neutrons, and electrons. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks
Unit 1 Interactions of Matter Part I (2 Weeks)					
Overarching Question(s)					
How are waves used to transfer energy and information?					
Unit, Lesson	**Lesson Length**	**Essential Question**		**Vocabulary**	
Unit 2 Interactions of Matter Part I	**2 weeks**	**<u>Essential Questions</u>** How are calculations impacted by the accuracy of measuring devices and the precision of the measurements? How do scientist's express quantities and convert them into different units?		Base unit, second, meter, amplitude, atomic emission spectrum, frequency, photoelectric effect, photon, Planck's constant, quantum, wavelength	
Standards and Related Background Information		**Instructional Focus**		**Instructional Resources**	

DCI
CHEM1.PS4: Waves and Their Applications in Technologies for Information Transfer

Standard
CHEM1.PS4.1 Using a model, explain why elements emit characteristic frequencies of light and how this information is used

Explanation
An understanding of the behavior of light as has been developed first by investigating properties of waves in fourth grade and more recently in eighth grade when students differentiated between mechanical and electromagnetic waves. This is the first time that students investigate a mechanism for the emission of photons. Emphasis should be placed on the emission of characteristic colors of light emitted when electrons undergo specific movements and unique spectra of each element that result. Students should explore the implications of these ideas on astronomy. (Clarification may be needed to differentiate this particulate behavior of light from previous discussions of its wave properties; however, discussions of Quantum Theory in differentiating wave-particle duality are beyond the scope of this standard).

Misconceptions
Atoms naturally emit light if they contain energy the emission of light has nothing to do with gaining energy from an outside source.

Learning Outcomes
Use SI system during measurement and problem solving.
Use a variety of appropriate notations (e.g., exponential, functional, square root).
Accuracy, precision, and error in a series of measurements.
Read/interpret graphs: (pie, bar, and line)
Interpret a Bohr model of an electron moving between its ground and excited states in terms of the absorption or emission of energy.

Phenomenon
Why does glow in the dark paint glow? Why do fireworks explode in various colors?
Help students understand the process of paint particles gaining energy from light and glowing as the excited electrons move from the excited state to the ground state.
Use a flame test lab to help students see the colors emitted from different metallic ions as they gain energy from the flame and remit it as the electrons move from the ground state to the excited state and them back to the ground state. Link this lab activity to the different colors we see as fireworks explode.

Curricular Materials

5E Lesson Resource Link

Textbook
Modern Chemistry Chap. 4
Modern Chemistry Chap. 3 Sec. 3

Laboratory Activities/Investigations
Flame test lab or demonstration
Modern Chemistry Teacher Resources
PhET labs based on simulations found at
https://colorado.edu/en/simulations/category/new

Simulations
Modern Chemistry Teacher Resources
https://phet.colorado.edu/en/simulation/wave-on-a-string
https://phet.colorado.edu/en/simulation/legacy/photoelectric
https://phet.colorado.edu/en/simulation/legacy/discharge-lamps
https://phet.colorado.edu/en/simulation/molecules-and-light
https://phet.colorado.edu/en/simulation//legacy/hydrogen-atom
Modern Chemistry Teacher Resources: Energy Levels of an Atom (Animation)

Videos
Modern Chemistry Web Resources:
http://winter.group.shef.ac.uk/orbitron/ (shapes of orbitals)

Articles
Modern Chemistry p.114 The Noble Decade

<u>Science and Engineering Practice</u> **Developing and using models** Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system. **<u>Cross Cutting Concepts</u>** **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.		**https://www.ck12.org/c/chemistry/photoelectric-effect/lesson/Photoelectric-Effect-CHEM/?referrer=concept_detail** **<u>Performance Tasks:</u>** Have two students hold a coiled spring or slinky along the floor or a tabletop. Ask one of the students to begin moving the spring back and forth so that a wave pattern forms. Students should describe how the wavelength changes as the frequency of the movement is increased and then decreased. Students should draw a wave model and identify the trough, crest, wavelength, amplitude and frequency. This can then be related to the wavelength of light and then electrons in the atomic model. Students will observe gas tube or flame test colors of metals compounds using diffraction gratings or a simulation. Students will discuss why different metal compounds emit different colors. Students should then relate and discuss the relationship to the excitement of electrons and loss of energy as the atoms returning to the ground state which releases energy that relates to a specific wavelength of light in the visible spectrum. Paint a piece of poster board with glow in the dark paint. Turn of the lights in the classroom if it can be made dark by doing so. Expose the board to a camera flash while a student holds their hand in front of the board. The students should see that the paint glows where the flash hit the board but does not where the hand was held during the flash. Use this to lead the students to a discussion of electrons moving from the ground state to the excited state and then back to the ground state. Encourage students to use the terms ground state, excited state, and energy levels. Use this to lead into the photoelectric effect.

		Students will write orbital notations for various elements from the periodic table. Students will apply this concept to the organization of the periodic table. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks
Unit 1 Interactions of Matter Part I (1.2 Weeks)					
Overarching Question(s)					
How are waves used to transfer energy and information?					
Unit, Lesson	**Lesson Length**	**Essential Question**		**Vocabulary**	
Unit 2 Interactions of Matter Part I	**7 days**	**<u>Essential Questions</u>** • How is the position and energy of a specific electron assigned for an atom? • How is the charge on anions and cations determined by electron configurations? • How does the structure of matter determine its chemical and physical properties? • How does the structure of the periodic table allow us to predict the chemical and physical properties of an element? • How is the periodic table a template of organization for the material world?		Periodic law, periodic table, lanthanide, actinide, alkali metals, alkaline earth metals, periodicity, Mendeleev, Moseley, transition elements, main-group elements, halogens, atomic radius, ion, ionization, ionization energy, electron affinity, cation, anion, valence electron, electronegativity	
Standards and Related Background Information		**Instructional Focus**		**Instructional Resources**	

DCI
CHEM1.PS1: Matter and Its Interactions

Standard
CHEM1.PS1.12 Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location of the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic
table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e. arrows representing electrons in an orbital).

Explanation
The concepts addressed in this standard appear as patterns leading to the arrangement of the periodic table or are patterns in the behavior of atom which can be explained by patterns within the periodic table. Students should engage in activities that provide opportunities to uncover these patterns. For example, an appropriate discussion of orbital notations would relate back to the organization of the periodic table, rather than merely following a chart simplifying the aufbau principle. Patterns for reactivity can be uncovered through investigation.

Learning Outcomes
- Interpret the periodic table to describe an element's atomic makeup.
- Apply the periodic table to determine the number of protons and electrons in a neutral atom.
- Distinguish between the subatomic particles in terms of relative charge and mass.
- Describe the structure of the atom, including the locations of the subatomic particles.
- Calculate the number of electrons, protons, and neutrons in an atom, given its mass number and atomic number.
- Draw Bohr models of the first 18 elements.
- Identify the *s*, *p*, *d*, and *f* blocks based on their electron configuration and location on the periodic table.
- Represent an electron's location in the quantum mechanical model of an atom in terms of the shape of electron clouds (s and p orbitals in particular), relative energies of orbitals, and the number of electrons possible in the s, p, d, and f orbitals. (Heisenberg Uncertainty Principle)
- Use the periodic table to identify an element as a metal, nonmetal, or metalloid
- Apply the periodic table to determine the number of protons and electrons in a neutral atom
- Define and calculate an isotope.
- Determine the number of protons and neutrons for a particular isotope of an atom
- Determine the Lewis electron dot structure or number of valence electron from an atom of any main-group element from its atomic number or position in the periodic table.

Phenomenon

Curricular Materials

5E Lesson Link

Textbook
Modern Chemistry Ch. 5

Laboratory Activities/Investigations
Modern Chemistry Quick Lab p. 134 Designing Your Own Periodic Table
Labs accompanying PhET simulations
https://phet.colorado.edu/en/simulations/category/chemistry

Simulations
Modern Chemistry Ch. 5 Teacher Resources: Animated Chemistry: Periodic Trends
https://phet.colorado.edu/en/simulation/build-an-atom
https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass
http://phet.colorado.edu/en/simulation/hydrogen-atom

Video
Modern Chemistry: Why It Matters Video: Periodic Law

Articles
https://www.ck12.org/c/chemistry/early-history-of-the-periodic-table/rwa/Finding-Patterns-in-Elemental-Behavior/?referrer=concept_details
Modern Chemistry Ch. 5 p. 143 Material Scientists
Modern Chemistry Ch. 5 169A The Pieces Everything is Made of: A Table for Putting Small Pieces in Order

Performance Tasks

Misconceptions There is no pattern to the organization of the periodic table. **Science and Engineering Practice** **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion. **Cross Cutting Concepts** **Patterns** Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations.	Relate the trends of the periodic table to trends in fashion and trends among teenagers. Students understand trends in fashion as things that everyone is doing. Relate the ideas of trends in society to the repetition of characteristics within groups and periods in the periodic table.	Modern Chemistry Web Resources: http://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass Electron Configuration Battleship – Divide into pairs, each student has a laminated Periodic Table (or one in a sheet protector) and dry erase marker. They mark out their 4 "ships" on the table (3, 4, or 5 elements in a row) with a dry erase marker. Without looking at their partner's board, students guess the location of the ships by using the electron configuration for the corresponding element location. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks

Unit 1 Interactions of Matter Part I (5 days)			
Overarching Question(s)			
How are waves used to transfer energy and information?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**5 days**	**Essential Questions** • How does a study of valence electrons help to explain most chemical phenomena? • How does chemical naming exhibit organizational patterns?	chemical bond, cation, anion, ionic bond, ionic compound, covalent bond, covalent compound, crystal lattice, electrolyte, lattice energy, formula unit, monatomic ion, oxidation number, polyatomic ion, structural formula, resonance, coordinate covalent bond

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.13** Use the periodic table and electronegativity differences of elements to predict the types of bonds that are formed between atoms during chemical reactions and write the names of chemical compounds, including polyatomic ions using IUPAC criteria. **Explanation**	**Learning Outcomes** • Analyze ionic and covalent compounds in terms of their formation, names, chemical formulas, percent composition, and molar masses. • Determine the types of chemical bond that occurs in a chemical compound. **Phenomenon** Relate the melting point and boiling point of different ionic and covalent compounds to the bond type. This could be done using an inquiry lab where student test the melting point and boiling point and electrical conductivity of various compounds and classify the compound as ionic or covalent	**Curricular Materials** 5E Lesson Resource Link **Textbook** Modern Chemistry Ch. 6 & 7 **Laboratory Activities/Investigations** Modern Chemistry Lab: Conductivity as an Indicator of Bond Type Determining the percentage of water in copper sulfate pentahydrate Modern Chemistry Teacher Resource: Determining the Empirical Formula of MgO.

It is recognized that the determination of exact bond classifications based on electronegativity can differ from one suggestion to the next. While specific values may change from one classroom to the next, attention should be paid to the underlying idea that all bonds represent some form of electromagnetic (electrostatic attraction). The differences between bond types can then be related back to cause for the electrostatic attraction, whether or not atoms are ionized when they interact. **Misconceptions** Electronegativity difference can always be used to determine the type of bond. For example, the electronegativity difference between boron and fluorine is 2.0. Yet scientist know through experimentation that boron trifluoride is a covalently bonded compound. **Science and Engineering Practice** **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion **Cross Cutting Concepts** **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.	based on both the chemical formula, electronegativity, conductivity and the melting and boiling point. Relate chemical bonds to people in a crowded elevator. As people squeeze into the confined space, they come in contact with each other. Many people will experience a sense of being too close together and wanting to push others away from them. Likewise, when atoms get close enough, their outer electrons repel each other. But in contrast to the people in the elevator the electrons of one atom are attracted to the nucleus of the other atom. The degree of attracting determines the type of chemical bond.	Inquiry labs accompanying PhET simulations https://phet.colorado.edu/en/simulations/category/chemistry **Simulations** Modern Chemistry Teacher Resources: Why It Matters Video: Chemical Bonding Modern Chemistry Teacher Resources: Animated Chemistry: Types of Bonds Modern Chemistry Teacher Resources: Why It Matters: Formulas and Compounds Modern Chemistry Teacher Resources: Formula Mass and Molar Mass (Animation) **Video** http://www.visionlearning.com/library/module_viewer.php?mid=55# https://phet.colorado.edu/en/simulation/build-a-molecule https://phet.colorado.edu/en/simulation/legacy/conductivity **Articles** **Modern Chemistry** p. 176 Waste to Energy **https://www.ck12.org/c/chemistry/chemical-bond/rwa/Bond-Chemical-Bond/?referrer=concept_details** Modern Chemistry Teacher Resources **Performance Tasks** ● Students will take 3 samples of ionic compounds and 3 samples of covalent compounds and using a can lid and candle will test the samples for their melting point. All samples will be place on the can lid at the same time. Students will then use a ring stand and ring to support the can lid. Students will

		then light a candle and place under the can lid. Students will then rank the compounds by order of melting. Students then use their knowledge of the properties of ionic and covalent compounds to classify the compounds as either ionic or covalent. • Students will be given names several compounds. Students will then classify the compounds as ionic or covalent. Students will then use the appropriate rules for naming the compounds. • Students carry out the lab Determining the Empirical Formula of MgO and practice the process and steps to determining the empirical formula from lab data. **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		Quarter 2	Quarter 3		Quarter 4
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry

5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks

Unit 1 Interactions of Matter Part I (5 days)			
Overarching Question(s)			
How are waves used to transfer energy and information?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**5 days**	**Essential Questions** • How do the charges of electrons affect bond geometry?	linear, bent, trigonal planar, trigonal pyramidal, tetrahedral, polar, polarity, VSEPR, valence electrons
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
DCI **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.14** Use Lewis dot structure and electronegativity differences to predict the polarities of simple molecules (linear, bent, trigonal planar, trigonal pyramidal, tetrahedral). Construct an argument to explain how electronegativity affects the polarity of chemical molecules. **Explanation** The focus of this standard is on considering the polarity of molecules and the factors that influence that polarity. There are two separate strands of understanding associated with this concept. The first strand addresses the use of electronegativity in considering polarity. This level of understanding can be applied at a simple level to binary compounds, but may prove insufficient to explain the polarity of more		**Learning Outcomes** • Analyze compounds according to elements and their valence electrons. • Determine number of bonding and non-bonding electrons and how they affect the molecular shape. (VSEPR) • Determine how the molecular shape of a compound affects its polarity. **Phenomenon** How can molecular geometry affect how substances interact; example why oil does not mix with water or why ionic compounds do mix with water? Have students observe the mixing of oil and water and then of alcohol and water. Show students the molecular structure of alcohol, water and oi. Help the student analyze the structure for similarities and differences. Lead the students to see how water is more like alcohol than oil and then to an understanding of why oil and water do not mix and why alcohol and water will mix. How does soap remove stains from your clothing? Students try to clean different stains from a fabric with or without soap and using different solvents. This simulation	**Curricular Materials** 5E Lesson Resource Link **Textbook** Modern Chemistry Ch. 6 Sec 5 **Laboratory** Modern Chemistry Lab: Repulsion Convulsion: determining the effect of unshared electrons on molecule shape **Virtual Lab** http://phet.colorado.edu/en/simulation/build-a-molecule **Activities/Investigations** Modern Chemistry Teacher Resources: Science Explore Labs accompanying PhET simulations Video

complex compounds. The second strand of this standard also incorporates the shape of molecules to explain polarities. Student should be able to consider a given Lewis structure and determine the shape of the molecule as well as the polarity, taking the distribution of electron density into account when determining shape. *(Only molecules following the octet rule will be included, though molecules such as sulfur dioxide might be used during instruction to illustrate the effect of the unshared pair of electrons on the shape of the molecule, as compared to carbon dioxide which lacks this unshared pair. The additional repulsion of a lone pair to disrupt symmetry but not actual bond angles will be included.)* **Misconceptions** Students may think that atoms within molecules are arranged in a flat plane, when in reality they have a 3-D shape. **Science and Engineering Practice** **Obtaining, evaluating, and communicating information** Students can provide written and oral explanations for phenomena and multi- part systems using models, graphs, data tables, and diagrams. **Cross Cutting Concepts** **Structure and Function** Students infer the function of a component of a system based on its shape and interactions with other components	works well for both middle school or high school students depending on how it is used. For younger students, focus on the concept of 'like dissolves like' and mixtures. For older students the focus can shift to polarity, colloids, and micelles. This simulation can also be used when discussing cell membranes in biology. **Performance Tasks** Students will be given binary compound names and will then classify the bonds based on differences in electronegativity as either polar or nonpolar. Modern Chemistry Teacher Resources	Modern Chemistry Web Resource: Lewis Dot Diagrams http://library.thinkquest.org/10429/low/bonding/bonding.htm **Simulations** Modern Chemistry Teacher Web Resources: Molecular Geometry Video http://library.thinkquest.org/10429/low/geometry/geobody.htm **Articles** **https://www.ck12.org/c/chemistry/lewis-electron-dot-structures/rwa/A-Simple-Code/?referrer=concept_details** **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		**Quarter 2**	**Quarter 3**		**Quarter 4**
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry

5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks

Unit 1 **Interactions of Matter Part I (5 days)**			
Overarching Question(s)			
How can one predict an object's continued motion, changes in motion, or stability?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**5 days**	**Essential Questions** • Differentiate between ionic and covalent bond models.	linear, bent, trigonal planar, trigonal pyramidal, tetrahedral, polar, polarity, VSEPR, valence electrons

Standards and Related Background Information	**Instructional Focus**	**Instructional Resources**
DCI **CHEM1.PS2:** Motion and Stability: Forces and Interactions **Standard** **CHEM1.PS2.1** Draw, identify, and contrast graphical representations of chemical bonds (ionic, covalent, and metallic) based on chemical formulas. Construct and communicate explanations to show that atoms combine by transferring or sharing electrons. **Explanation** This standard resumes discussions of interactions between atoms from 7.PS1. In seventh grade, students observed patterns within the periodic table that related the physical and chemical properties of substances to the location of the constituent elements on the periodic table. Revisiting general trends is likely to be necessary however a focus should be placed on the	**Learning Outcomes** Differentiate between ionic and covalent bond models. **Phenomenon** Have students compare the brittleness of ionic crystals to that of covalent crystals and metallic substance by hitting them with a hammer. Students can then look at the structure of each and analyze the attraction between particles to use guided inquiry to analyze why the ionic compounds are brittle and fall apart when hit with a hammer and why metals simply are hammered into a thin sheet. Students could also test the melting point of various ionic and covalent compounds noting that ionic compounds melt at high temperatures than do covalent compounds. **Performance Tasks** Students will be given several basic covalent compound names and the students will draw Lewis structures for these compounds. Students will then use either molecule kits or gumdrops and toothpicks or marshmallows and build the molecule. Students will then label the bonds as polar or	**Curricular Materials** 5E Lesson Resource Link **Textbook** Modern Chemistry Ch. 6 **Video** Modern Chemistry: Why It Matters: Chemical Bonds **Laboratory Activities/Investigations** Modern Chemistry Teacher Resources: 1) Chemical Bond Type (Virtual Lab) 2) Chemical Bonds: Test various substance in the lab and determine the bond type base on characteristics. **Simulations** Modern Chemistry Teacher Resources https://phet.colorado.edu/en/simulation/build-a-molecule https://phet.colorado.edu/en/simulation/legacy/sugar-and-salt-solutions

transfer of electrons underlying differences in properties. It is beneficial to show that electrostatic interactions occur even between two non-conductors. Demonstrations can be carried out by using static charge to hold a balloon against a wall or showing that oppositely charged pieces of invisible tape are attracted not only to each other but also to neutral conductors and non- conductors such as foil strips or paper. **Misconceptions** Students do not understand that the chemical formula for ionic compounds represent the simplest formula of the compound, as opposed to the formulas for molecules that are each a discrete group of atoms. **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion. **Cross Cutting Concepts** **Structure and Function** Students apply patterns in structure and function to unfamiliar phenomena.	nonpolar and then use molecule structure and symmetry to classify the bond as either polar or nonpolar.	Modern Chemistry Web Resources: Ionic Bond Interactive: http://www.learner.org/interactives/periodic/groups_interactive.html Modern Chemistry WebResource: Molecular Bonding Interactive Quiz: http://www.teachersdomain.org/resource/lsps07.sci.phys.matter.molecularshp/ **Articles** **https://www.ck12.org/c/chemistry/ionic-bond/rwa/Give-Me-a-Big-Smile/?referrer=concept_details** Modern Chemistry Teacher Resources **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Chemistry Quarter 1 Curriculum Map					
Quarter 1		**Quarter 2**	**Quarter 3**		**Quarter 4**
Unit 1 Atomic Structure	Unit 2 Interactions of Matter Part I	Unit 3 Interactions of Matter Part II	Unit 4 Interactions of Matter Part III	Unit 5 Matter and Energy	Unit 6 Acid & Bases and Nuclear Chemistry
5 weeks	4 weeks	9 weeks	3 weeks	**6 weeks**	9 weeks
Unit 1 Interactions of Matter Part I (3 days)					

Overarching Question(s)			
How can one predict an object's continued motion, changes in motion, or stability?			
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 2 Interactions of Matter Part I	**3 days**	**Essential Questions** How does the kinetic-molecular theory explain the properties of solids, liquids, and gases in terms of particle energy and the forces between particles?	Dipole-dipole forces, dipole, hydrogen bonding, London dispersion forces, unshared electron pairs, induced dipole

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI **CHEM1.PS2:** Motion and Stability: Forces and Interactions **Standard** **CHEM1.PS2.2** Understand that intermolecular forces created by the unequal distribution of charges result in varying degrees of attraction between molecules. Compare and contrast the intermolecular forces (hydrogen bonding, dipole-dipole bonding and London dispersion forces) within different types of simple substances (only those following the octet rule) and predict and explain their effect on chemical and physical properties of those substances using models or graphical representations. **Explanation** This standard resumes where students left off in 7.PS1. Students' first exposure to all three phases of matter was in third grade, by fifth grade students were investigating phase changes in matter. These discussions have not included a mechanism to explain why states of matter are dependent on	**Learning Outcomes** Contrast the arrangement of particles in solids, liquids, and gases. Explain how the addition and removal of energy can cause a phase change. Interpret a phase diagram **Phenomenon** Discuss and have the students explain the difference between the boiling point of water and a substance such as alcohol. Students could measure the boiling point of both alcohol and water. Have students then explain phenomenon like why it hurts to dive off of the diving board and land on your back or why you can pour water over the top of a cup and it will form a convex surface but alcohol will not. This should involve student analysis of molecular structure, shape and polarity to develop an understanding of attraction between molecules that lead to the properties of molecules.	**Curricular Materials** Engage Explore Explain Elaborate Evaluate **Textbook** Modern Chemistry Ch. 6 Sec 5 **Laboratory Activities/Investigations** https://www.ck12.org/c/chemistry/polar-molecules/rwa/The-Lotus-Effect/?referrer=concept_details Modern Chemistry Teacher Resources **Simulations** https://interactives.ck12.org/simulations/chemistry/intermolecular-forces/app/index.html?hash=df10549a742e131936d1039b5fb2fd1a&source=ck12&artifactID=2931916&r

temperature and pressure. Students should consider this standard in conjunction with CHEM1.PS2.1 to explore differences in intermolecular attractions within molecular and ionic compounds and the behavior of electrons leading to these differences. **Misconceptions** Many students think of hydrogen bonding as a separate type of intermolecular force. In fact, it is a particularly strong dipole-dipole force. **Science and Engineering Practice** **Developing and using models** Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system. **Cross Cutting Concepts** **Stability and Change** Students provide examples and explanations for sudden and gradual changes.		**eferrer=concept_details&backUrl=https%3A//www.ck12.org/c/chemistry/polar-molecules/%23simulations** **Modern Chemistry Web Resources:** Practice Quiz: http://www.pbs.org/wgbh/nova/tech/chemical-bonds-quiz.html http://phet.colorado.edu/en/simulation/molecule-polarity Modern Chemistry Web Resource: Intermolecular Forces: http://www.chem.arizona.edu/chemt/Flash/hbond.html **Articles** **https://www.ck12.org/c/chemistry/polar-molecules/rwa/The-Lotus-Effect/?referrer=concept_details** Modern Chemistry Teacher Resources **Performance Tasks** Modern Chemistry Teacher Resources Students will use the following link to perform the simulation involving intermolecular forces. **https://www.ck12.org/c/chemistry/polar-molecules/rwa/The-Lotus-Effect/?referrer=concept_details** **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Quarter 1		Chemistry	
Textbook Resources **Textbook** Modern Chemistry Ch. 3 & 4 Modern Chemistry p. 73 Quick Lab Modern Chemistry p. 72 Nanotechnologist Modern Chemistry Ch. 4 Modern Chemistry p.114 The Noble Decade Modern Chemistry Ch. 5 Modern Chemistry Quick Lab p. 134 Designing Your Own Periodic Table Modern Chemistry Chap. 5 Teacher Resources: Animated Chemistry: Periodic Trends Modern Chemistry Chap. 5 p. 143 Material Scientists Modern Chemistry Chap. 5 169A The Pieces Modern Chemistry Ch. 3 & 4 Modern Chemistry Ch. 4 Modern Chemistry Ch. 3 Sec. 3 Modern Chemistry Ch. 5 Modern Chemistry Quick Lab p. 134 Designing Your Own Periodic Table Modern Chemistry Ch. 6 & 7 5E Lesson Resource Link	**DCIs and Standards** **DCI** **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.11** Develop and compare historical models of the atom (from Democritus to quantum model) and construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations. **DCI** **CHEM1.PS4:** Waves and Their Applications in Technologies for Information Transfer **Standard** **CHEM1.PS4.1** Using a model, explain why elements emit characteristic frequencies of light and how this information is used **DCI** **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.12** Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location of the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e. arrows representing electrons in an orbital). **DCI** **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.11** Develop and compare historical models of the atom (from Democritus to	**Videos** Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The TeachingChannel Teachertube.com Modern Chemistry Web Resources: http://www.visionlearning.com/library/module_viewer.php?mid=49&l Phet labs to accompany PhET simulations https://colorado.edu/en/simulations/category/new **Simulations** Modern Chemistry Web Resources: History of Atom and Hydrogen & Helium: http://www.visionlearning.com/library/module_viewer.php?mid=50 Ions, atoms, molecules simulation: http://www.visionlearning.com/library/module_viewer.php?mid=51 https://phet.colorado.edu/en/simulation/rutherford-scattering Modern Chemistry Web Resources: Tutorial http://www.teachersdomain.org/asset/lsps07_int_theatom/ Model Building Interaction: http://phet.colorado.edu/en/simulation/build-an-atom PhET labs based on simulations found at https://colorado.edu/en/simulations/category/new **Simulations** Modern Chemistry Teacher Resources https://phet.colorado.edu/en/simulation/wave-on-a-string https://phet.colorado.edu/en/simulation/legacy/photoelectric https://phet.colorado.edu/en/simulation/legacy/discharge-lamps https://phet.colorado.edu/en/simulation/molecules-and-light	**Additional Resources:** **ACT & SAT** TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy

	quantum model) and construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations **DCI** **CHEM1.PS4:** Waves and Their Applications in Technologies for Information Transfer **Standard** **CHEM1.PS4.1** Using a model, explain why elements emit characteristic frequencies of light and how this information is used **DCI** **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.12** Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location of the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e. arrows representing electrons in an orbital). **DCI** **CHEM1.PS1:** Matter and Its Interactions **Standard** **CHEM1.PS1.13** Use the periodic table and electronegativity differences of elements to predict the types of bonds that are formed between atoms during chemical reactions and write the names of chemical compounds, including polyatomic ions using IUPAC criteria. **DCI** **CHEM1.PS2:** Motion and Stability: Forces and Interactions **Standard**	https://phet.colorado.edu/en/simulation//legacy/hydrogen-atom **https://www.ck12.org/c/chemistry/photoelectric-effect/lesson/Photoelectric-Effect-CHEM/?referrer=concept_detail** Labs accompanying PhET simulations https://phet.colorado.edu/en/simulations/category/chemistry https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass http://phet.colorado.edu/en/simulation/hydrogen-atom **https://www.ck12.org/c/chemistry/early-history-of-the-periodic-table/rwa/Finding-Patterns-in-Elemental-Behavior/?referrer=concept_details** http://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass Interactive Video Modern Chemistry Web Resources: http://www.visionlearning.com/library/module_viewer.php?mid=49&l **Laboratory Activities/Investigations** Modern Chemistry p. 73 Quick Lab Phet labs to accompany PhET simulations https://colorado.edu/en/simulations/category/new **Simulations** Modern Chemistry Web Resources: History of Atom and Hydrogen & Helium: http://www.visionlearning.com/library/module_viewer.php?mid=50 Ions, atoms, molecules simulation: http://www.visionlearning.com/library/module_viewer.php?mid=51 https://phet.colorado.edu/en/simulation/rutherford-scattering **Articles** **https://www.ck12.org/c/chemistry/history-of-chemistry/lesson/Events-in-Chemistry-History-CHEM/?referrer=concept_details** Flame test lab or demonstration Modern Chemistry Teacher Resources PhET labs based on simulations found at https://colorado.edu/en/simulations/category/new **Simulations**	

	CHEM1.PS2.1 Draw, identify, and contrast graphical representations of chemical bonds (ionic, covalent, and metallic) based on chemical formulas. Construct and communicate explanations to show that atoms combine by transferring or sharing electrons. **DCI** **CHEM1.PS2:** Motion and Stability: Forces and Interactions **Standard** **CHEM1.PS2.2** Understand that intermolecular forces created by the unequal distribution of charges result in varying degrees of attraction between molecules. Compare and contrast the intermolecular forces (hydrogen bonding, dipole-dipole bonding and London dispersion forces) within different types of simple substances (only those following the octet rule) and predict and explain their effect on chemical and physical properties of those substances using models or graphical representations	Modern Chemistry Teacher Resources https://phet.colorado.edu/en/simulation/wave-on-a-string https://phet.colorado.edu/en/simulation/legacy/photoelectric https://phet.colorado.edu/en/simulation/legacy/discharge-lamps https://phet.colorado.edu/en/simulation/molecules-and-light https://phet.colorado.edu/en/simulation//legacy/hydrogen-atom Modern Chemistry Teacher Resources: Energy Levels of an Atom (Animation) **Videos** **Modern Chemistry Web Resources:** http://winter.group.shef.ac.uk/orbitron/ (shapes of orbitals) **Articles** Modern Chemistry p.114 The Noble Decade **https://www.ck12.org/c/chemistry/photoelectric-effect/lesson/Photoelectric-Effect-CHEM/?referrer=concept_detail** Labs accompanying PhET simulations https://phet.colorado.edu/en/simulations/category/chemistry **Simulations** Modern Chemistry Ch. 5 Teacher Resources: Animated Chemistry: Periodic Trends https://phet.colorado.edu/en/simulation/build-an-atom https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass http://phet.colorado.edu/en/simulation/hydrogen-atom **Video** Modern Chemistry: Why It Matters Video: Periodic Law **Articles** **https://www.ck12.org/c/chemistry/early-history-of-the-periodic-table/rwa/Finding-Patterns-in-Elemental-Behavior/?referrer=concept_details** Modern Chemistry Web Resources: http://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass	

		Inquiry labs accompanying PhET simulations https://phet.colorado.edu/en/simulations/category/chemistry Video http://www.visionlearning.com/library/module_viewer.php?mid=55# https://phet.colorado.edu/en/simulation/build-a-molecule https://phet.colorado.edu/en/simulation/legacy/conductivity **Articles** **Modern Chemistry** p. 176 Waste to Energy **https://www.ck12.org/c/chemistry/chemical-bond/rwa/Bond-Chemical-Bond/?referrer=concept_details** Modern Chemistry Teacher Resources https://phet.colorado.edu/en/simulation/build-a-molecule https://phet.colorado.edu/en/simulation/legacy/sugar-and-salt-solutions Modern Chemistry Web Resources: Ionic Bond Interactive: http://www.learner.org/interactives/periodic/groups_interactive.html Modern Chemistry WebResource: Molecular Bonding Interactive Quiz: http://www.teachersdomain.org/resource/lsps07.sci.phys.matter.molecularshp/ **Articles** **https://www.ck12.org/c/chemistry/ionic-bond/rwa/Give-Me-a-Big-Smile/?referrer=concept_details** **Laboratory Activities/Investigations** **https://www.ck12.org/c/chemistry/polar-molecules/rwa/The-Lotus-Effect/?referrer=concept_details** Modern Chemistry Teacher Resources **Simulations** **https://interactives.ck12.org/simulations/chemistry/intermolecular-forces/app/index.html?hash=df10549a742e131936d1039b5fb2fd1a&source=ck12&artifactID=2931916&referrer=concept_details&backUrl=https%3A**	

		//www.ck12.org/c/chemistry/polar-molecules/%23simulations **Modern Chemistry Web Resources:** Practice Quiz: http://www.pbs.org/wgbh/nova/tech/chemical-bonds-quiz.html http://phet.colorado.edu/en/simulation/molecule-polarity Modern Chemistry Web Resource: Intermolecular Forces: http://www.chem.arizona.edu/chemt/Flash/hbond.html **Articles** **https://www.ck12.org/c/chemistry/polar-molecules/rwa/The-Lotus-Effect/?referrer=concept_details**	