## 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.

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.

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

| Unit 3<br>Interactions of Matter Part II (9 Weeks) | | | |
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| **Overarching Question(s)** | | | |
| How do particles combine to form the variety of matter one observes? | | | |
| **Unit, Lesson** | **Lesson Length** | **Essential Question** | **Vocabulary** |
| Unit 1<br>Atomic Structure | **week** | **Essential Questions**<br>● How does the Law of Conservation of Matter allow you to determine the empirical/ molecular formula of a compound? | Moles, molar mass, formula mass, percentage composition, molarity, Avogadro's number, molar volume of a gas at STP, molecular formula, empirical formula |
| **Standards and Related Background Information** | | **Instructional Focus** | **Instructional Resources** |
| **DCI**<br><br>CHEM1.PS1: Matter and Its Interactions<br><br>**Standards**<br><br>CHEM1.PS1.1 Understand and be prepared to use values specific to chemical processes: the mole, molar mass, molarity, and percent composition. **focus should be on moles and molar mass and should complement CHEM1.PS1.3.*<br><br>**Explanation**<br><br>The concept of relative mass can be explored by comparing small groups of like items. For | | **Learning Outcomes**<br><br>● Calculate the molar mass of a compound.<br>● Calculate percent composition of a compound.<br>● Convert among the following quantities of a substance; mass, number of moles, number of particles, molar volume of STP number<br>● Calculate the empirical formula of a compound.<br>● Determine a molecular formula from an empirical formula.<br>**Phenomena**<br><br>● Write a common chemical formula, such as the formula for water, on the board. Then hold up or pass around a model of a water molecule. Have students identify the number of hydrogen and oxygen in one water molecule. Have students brainstorm with a partner | **Curricular Resources**<br>Engage<br><br>Explore<br><br>Explain<br><br>Elaborate<br><br>Evaluate<br><br>**Textbook:**<br><br>_Modern Chemistry Chap. 3 Sec 3; Chp. 7 Sec. 3 & 4<br><br>**Laboratory Activities/Investigations:** Modern Chemistry |

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| example, relative masses of beans can be compared with pinto, white, and black beans. If bags are created with equal numbers of like beans, students can develop a concept of why the smallest bean will have a relative mass of 1, analogous to hydrogen.<br><br>**Misconceptions**<br><br>Confusion of molar mass and atomic mass. Although they are often the same number, atomic mass is the mass of one atom, expressed in amu, and molar mass is the mass of one mole of particles, expressed in g/mol.<br><br>**Explanation**<br>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.<br>**Misconceptions**<br>Atoms are round solid sphere containing no smaller particles.<br>***Science and Engineering Practice***<br>**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. | how they could calculate the mass of one water molecule by using the periodic table. Next have student expand on this idea to include the mass of many water molecules.<br>Show the students models of molecules in which the numbers of the various types of atoms differ but the ratios are the same, for example $NO_2$ and $N_2O_4$. Have students analyze and compare and contrast the molecules. Help students note that they are both made of the same elements in the same ratio but they have different formulas. This will help lead students to the concept of empirical formula. | Teacher Resources:<br><br>Labs: Sec 3.3<br><br>• These labs and activities are contained with in the Modern Chemistry Teacher Resources<br>Conservation of Mass<br><br>• Exploring the Mole<br>• Section 7.3: Hydrates—Gypsum and Plaster of Paris<br>• Section 7.3: Percent Composition of Hydrates<br>• Section 7.3: Water of Hydration<br>Labs Sec 7.4<br><br>• Virtual Lab: Determining Empirical Formulas<br>• Determining the Empirical Formula of Magnesium Oxide<br>• Gravimetric Analysis<br>**Simulations**<br><br>Modern Chemistry Teacher Resources:<br><br>• Chap 3 Sec. 3 Avogadro's number<br>• Chap. 7 Determining Empirical and Molecular Formulas: http://www.wisc-online.com/Objects/ViewObject.aspx?ID=GCH7204<br>• http://www.brightstorm.com/science/chemistry/chemical-reactions/empirical-formula-molecular-formula/<br>•<br>**Interactive Videos**<br><br>Modern Chemistry Teacher Resources:<br><br>Chap 3 Sec. 3:<br><br>• Gram to mole conversions<br>• Avogadro's number conversions |

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| <u>**Cross Cutting Concepts**</u><br>**Systems and System Models** Students create and manipulate a variety of different models: physical, mathematical, and computational.<br>***Science and Engineering Practices***<br>*Developing and using models*<br>*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.*<br>***Crosscutting Ideas***<br>*Scale, Proportion, and Quantity*<br>*Systems and System Models students create and manipulate a variety of different models: physical, mathematical, and computational.* | | ● Interactive Review<br>Chap. 7 Sec 3 & 4<br>● Interactive Review<br><u>**Articles**</u>:<br>Modern Chemistry Student Book: Nanotechnologist<br><u>**Videos**</u><br>Modern Chemistry Teacher Resources Videos:<br>● Why It Matters: Nuclear Chemistry<br>● Why It Matters: Formulas and Compounds (Relates gas chromatography to solving crimes by a forensic scientist)<br><u>**Performance Tasks:**</u><br>Teacher can use white boards to have students work problems with partners using dimensional analysis:<br>Students will perform calculations for molar mass, formula mass, conversions from grams to moles, moles to grams, moles to particles, particles to moles, percentage composition molecular formula introduction with the phenomena begin lessons for calculation of the molar mass and formula mass.<br>**Day 1** Review calculations of mass, moles, and Avogadro's number conversions for elements.<br>**Day 2** review molar mass and formula mass calculations having students perform calculations for more complex compounds such as compounds containing polyatomic ions.<br>**Day 3:** Begin lesson with an example of how students grades are calculated based on points scored vs. points available. Lead this discussion into how percentage composition of |

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| | | each element in a compound is like what part of the total individual elements makes up of the compound. Next introduce students to how the percentage composition of each element in the compound is calculated after finding the molar mass of the compounds by dividing the mass of the individual element in the compound by the total mass of the compound.<br><br>**Day 4:** Continue to practice calculations for percentage composition including calculating the percentage composition of a single element from the compound rather that all of the elements in the compounds<br><br>**Day 5**: Introduce students to the process of using dimensional analysis and conversion factors to have students convert from grams of a compound to moles, Reinforce the computation of molar mass.<br><br>**Day 6:** Extend students calculations of moles to grams by now reversing the process and calculating grams of a compound and converting to moles of a compound using conversion factors.<br><br>**Day 7**: Introduced Avogadro's number of particles in a mole. Use everyday examples of the quantity of a mole. For example how many gumballs would you have if you had a mole of gumballs. Or would you be happy if someone gave you a mole of pennies. You can then extend this to calculate how many dollars would be in a mole of pennies. This helps students understand the magnitude of Avogadro's number. Next involve the students in using Avogadro's number to convert from moles to number of particles.<br><br>**Day 8** Continue the process of using Avogadro's number for calculations. Extend to calculation from the number of |

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| | | particles of a substance to finding the number of moles of the substance using conversion factors.<br><br>**Day 9** Introduce the process of calculating from particles to mole to grams using conversion factors.<br><br>**Day 10** Introduce the process of calculating from grams to moles to particles so that students can proceed from any unit to any other unit.<br><br>**Day 11** Practice all types of conversions to help reinforce the concepts needed for future stoichiometry.<br><br>**Day 12** Introduce students to using data gathered from example analytical processes to calculate the empirical formula for a compound.  This lesson could be introduced by using the cells of the body as an example of the molecular formula and the amounts of the components within the cell as the empirical formula.  Use given data to introduce the idea that all amounts must be compared in moles since the amount of each element within a compound is compared based on moles.  Have students first reduce chemical formulas<br><br>**Day 13** Review previous days calculations of empirical formulas when given grams and proceed to using the molar mass of a compound to find the molecular formula.<br><br>**Day 14** Introduce the calculation and the process for making molar solutions.<br><br>Review all math concepts for this unit in preparation for a test and empirical formula<br><br>**Day 15** Review all calculations<br><br>**Additional Resources:** |

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| | | **ACT & SAT**<br>TN ACT Information & Resources<br>SAT Connections<br>SAT Practice from Khan Academy |

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

Unit 3
Atomic Structure (9 Weeks)

**Overarching Question(s)**

How are waves used to transfer energy and information?

| Unit, Lesson | Lesson Length | Essential Question | Vocabulary |
|---|---|---|---|
| Unit 2<br>Interactions of Matter<br>Part I | **2 weeks** | **Essential Questions**<br>How are chemical equations balanced in order to solve the law of conservation of mass? | Mass, law of conservation of mass, chemical reaction. Balance chemical equations, coefficient, mole-ratio. |

| Standards and Related Background Information | Instructional Focus | Instructional Resources |
|---|---|---|
| **DCI**<br><br>CHEM1.PS1: Matter and its Interaction<br><br>**Standard**<br><br>CHEM1.PS1.2 Demonstrate that atoms, and therefore mass, are conserved during a chemical reaction by balancing chemical reactions.<br><br>**Explanation**<br><br>This standard builds on the idea that balancing chemical reactions provides evidence for conservation of mass and that the behavior of atoms follows predictable patterns. Students now have the opportunity to utilize this understanding as they perform and evaluate chemical reactions. (The concepts of limiting reagent and percent yield are | **Learning Outcomes**<br><br>Balance chemical equations.<br><br>**Phenomenon**<br><br>● Show students a compound and then a chemical reaction by video or as a demo or a quick lab. Encourage to describe what is happening in the chemical reaction. Next have students brainstorm How they could convey what they observed to other students or scientist. Use this to lead students to see the importance of chemical equations in communicating chemical processes.<br>● Show students a group of plants or animals. Ask students how they would separate the animals or plants into groups. Next ask students if they think chemical reactions could also be separated into groups based on similar characteristics. Give students a set of chemical reactions. Have students group the reactions according to similarity while explaining why they group them together. This should lead to the | **Curricular Resources**<br>Engage<br><br>Explore<br><br>Explain<br><br>Elaborate<br><br>Evaluate<br><br>**Textbook**<br><br>Modern Chemistry Chp.8 Sec. 1<br><br>**Laboratory Activities/Investigations**<br><br>Virtual Fire lab |

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| presented; however, students are not expected to determine these values algebraically. Use of molar volume in stoichiometric processes is beyond the scope of this standard.)<br><br>**Misconceptions**<br><br>Students often think they can balance the elements on each side of an equation by changing the subscripts rather than changing the coefficient.<br><br>**Science and Engineering Practice**<br><br>Engaging in argument from evidence:<br><br>Students critically evaluate evidence supporting an argument and create written or oral arguments that invoke empirical evidence, scientific reasoning and scientific explanations.<br><br>**Cross Cutting Concepts**<br><br>Matter and Energy<br><br>Students demonstrate and explain conservation of mass and energy in systems, including systems with inputs and outputs. | discussion of types of chemical reactions. | http://www.pbs.org/wgbh/nova/physics/science-fire.html<br><br>Sec 8.1 Teacher Resources<br>● Blueprint Paper<br>● Getting a Reaction<br>Sec. 8.2 Teacher Resources<br>● Evidence of Chemical Change<br>● Balancing Equations Using Models<br>●<br>**Simulations**<br><br>Modern Chemistry Chap. 8 Sec 1Teacher<br><br>Resources<br>● http://phet.colorado.edu/en/simulation/balancing-chemical-equations<br>● http://phet.colorado.edu/en/simulation/reactants-products-and-leftovers<br>**Articles**<br><br>Modern Chemistry Student Edition:<br>● Chap 8 Sec. 1 Why It Matters: Carbon Monoxide Catalyst<br>**Videos**<br><br>Modern Chemistry Teacher Resource:<br>● Why It Matters: Equations and Reactions<br>● http://www.visionlearning.com/library/module_viewer.php?mid=54<br>● http://www.visionlearning.com/library/module_viewer.php?mid=56&l<br>● http://antoine.frostburg.edu/chem/senese/101/redox/faq/activity-series.shtml<br>**Performance Tasks**<br>● Students will balance chemical equations when given the reactions. |

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| | | **Day 1** Use a chemical reaction to introduce the lesson on chemical change in the form of either a video or demonstration. Discuss what things happening would indicate that a chemical change has occurred.  Discuss the difference in a physical change and a chemical change.  Give students scenarios and ask them to identify the changes as either chemical or physical.<br><br>**Day 2** Introduce students to chemical equations and the different parts of a chemical equation (reactants, products, yield, coefficients, chemical formulas).<br><br>**Day 3-5** Introduce the process of balancing chemical equations by adding coefficients.<br><br>**Day 6** Continue to balance more complex equations.<br><br>**Day 7** Quiz Balancing equations<br>**Additional Resources:**<br>**ACT & SAT**<br>TN ACT Information & Resources<br>SAT Connections<br>SAT Practice from Khan Academy |

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|---|---|---|---|---|---|
| **Quarter 1** | | **Quarter 2** | **Quarter 3** | | **Quarter 4** |
| Unit 1<br>Atomic Structure | Unit 2<br>Interactions of Matter<br>Part I | Unit 3<br>Interactions of Matter<br>Part II | Unit 4<br>Interactions of Matter<br>Part III | Unit 5<br>Matter and Energy | Unit 6<br>Acid & Bases and Nuclear Chemistry |
| 5 weeks | 4 weeks | 9 weeks | 3 weeks | **6 weeks** | 9 weeks |
| Unit 3<br>Interactions of Matter Part II (9 Weeks) | | | | | |
| **Overarching Question(s)** | | | | | |
| How are waves used to transfer energy and information? | | | | | |

| Unit, Lesson | Lesson Length | Essential Question | Vocabulary |
| --- | --- | --- | --- |
| Unit 3<br>Interactions of Matter<br>Part I | **1 week** | **Essential Questions**<br>● How does matter interact to cause energy changes?<br>● What is the relationship between intermolecular forces, bond types and activation energy?<br>● How do you distinguish exothermic and endothermic reactions? | Endothermic, exothermic, potential energy diagrams, activation energy |

| Standards and Related Background Information | Instructional Focus | Instructional Resources |
| --- | --- | --- |
| **DCI**<br><br>CHEM1.PS3: Energy<br><br>**Standard**<br><br>CHEM1.PS.3.3 Distinguish between endothermic and exothermic reaction by constructing potential energy diagrams and explain the differences between the two using chemical terms (activation energy). Recognize when energy is absorbed or given off depending on the bonds formed and bonds broken.<br><br>**Explanation**<br><br>Students should analyze data to see that kinetic energy is directly proportional to mass and to the square of velocity. Students can be provided data to carry out this analysis. Alternately, heavy objects can be dropped into beds of flour or soft material and comparisons of the indentions can be made. Doubling the mass and dropping from the same height will produce an indention with a volume twice as great. Dropping an object from a height twice as great leaves and indention with four times the volume. (Instruction of this standard can be limited to recognizing that as the speed of an object increases, the kinetic energy increases at a greater rate and describing qualitative changes to kinetic energy. | **Learning Outcomes**<br><br>● Compare and contrast heat and temperature changes in chemical and physical processes.<br>**Phenomenon**<br><br>Use of hot and cold packs depend on exothermic and endothermic heats of solution. Use hot and cold packs to demonstrate energy changes. Students can research chemicals that react to produce heat or absorb heat.<br><br>Instant hot packs and cold packs create thermal energy by dissolving salts. In this simulation, students explore endothermic and exothermic process by adjust the type of salt used in the pack. Depending on the type of salt the pack can be a hot pack, or it can be a cold pack!<br><br>How do hot packs and cold packs change temperature? Students explore students explore endothermic and exothermic process by adjust the type of salt used in the pack and reading energy diagrams. For younger students focus on the fact that heat can be released or absorbed when salts dissolve in water. Have students determine which salts produce heat when they dissolve and which absorbed heat. Concepts to focus on would be heat flowing from hot to cold objects, reading energy diagrams, and observing how salts dissolve in water. For more advanced students, ask students to develop an explanation for why some salts release heat while others do not.<br><br>**Energy Changes During Chemical Reactions** | **Curricular Resources**<br>Engage<br><br>Explore<br><br>Explain<br><br>Elaborate<br><br>Evaluate<br><br>**Textbook**<br><br>Modern Chemistry Chap. 6 Sec. 2; Chap. 12 Sec 2;<br><br>**Laboratory Activities/Investigations**<br><br>Modern Chemistry Chap. 6 Sec. 2; Chap. 12<br><br>**Simulations**<br><br>Modern Chemistry Chap. 6 Sec. 2; Chap. 12 Sec 2;<br><br>Teacher Resources<br><br>● https://interactives.ck12.org/simulations/chemistry/exothermic-and-endothermic/app/index.html?utm_source=projectphenomena&utm_medium=website&utm_campaign=ngss<br>● https://www.ck12.org/chemistry/exothermic-and- |

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| Creating proportionalities, graphing linear/quadratic relationships and exponents all exceed sixth grade Tennessee math standards, but can be used for enrichment in with advanced students.)<br><br>**Misconceptions**<br><br>Students often do not understand the changes in energy that occur as a result of chemical reactions. Students should be given examples of the breaking and reforming of chemical bonds and the energy changes that occur as atoms change bonding.<br><br>**Science and Engineering Practice**<br><br>Using mathematics and computational thinking.<br><br>Students can create computational or mathematical models for interactions in the natural world using unit equivalences.<br><br>**Cross Cutting Concepts**<br><br>Systems and System Models<br><br>Students design or define systems in order to evaluate a specific phenomenon or problem. | https://sites.google.com/site/sciencephenomena/<br><br>The decomposition of hydrogen peroxide is an exothermic reaction. Hydrogen peroxide on its own will decompose into water and oxygen gas. A catalyst will speed up this reaction so the students will be able to visualize this phenomenon. The reaction gives the oxygen gas a medium to travel through with the soap as well as observable steam.<br><br>**Suggestions for Classroom Use:**<br><br>Resource 1 is a video to demonstrate an exothermic reaction. This video will be used for students to gage prior knowledge, observe and generate questions related to this phenomenon. The teacher will guide the discussion to address that energy in the form of heat is being released (as steam) in this particular reaction. Resource 2 is a lab activity for the students. Students will conduct two chemical reactions. In the first, the temperature will go down (endothermic) and in the second, the temperature will go up (exothermic) Resource 3 is an animation of both types of chemical reactions. Students will see an animation to review a concept that was introduced by the teacher that it takes energy to break bonds and that energy is released when new bonds are formed. Students will use this idea to explain why a reaction is either endothermic or exothermic. | endothermic-processes/<br>• https://www.ck12.org/chemistry/Heat-of-Solution/<br>• http://phet.colorado.edu/en/simulation/energy-forms-and-changes<br>• http://www.chm.davidson.edu/vce/calorimetry/SpecificHeatCapacityOfCopper.html<br>**Videos**<br>• http://www.teachersdomain.org/asset/rr10_vid_endoexo/<br>• http://www.brightstorm.com/science/chemistry/thermochemistry/specific-heat/<br>**Articles**<br><br>Modern Chemistry Chap. 6 Sec. 2; Chap. 12 Sec 2;<br><br>**Performance Tasks**<br><br>• Students will classify processes and reactions as endothermic or exothermic base on the change in temperature, the production or absorption of energy, and heat flow.<br><br>• Students will interpret energy diagrams for chemical reactions to classify the reaction as endothermic or exothermic and identify the amount of activation energy required to start the reaction.<br><br>**Day 1** Introduction of thermal reaction Diagrams. Create graphic organizers for terms.<br>**Day 2** Students complete and share graphic organizers.<br>**Day 3** Thermo lab for endothermic reaction. https://www.carolina.com/teacher-resources/Interactive/thermochemistry-an-endothermic-reaction/tr41415.tr<br>**Day 4** Students compute and compare data from lab.<br>**Day 5** Thermo Lab 2.<br>http://www.inquiryinaction.org/classroomactivities/activity.php?id=24 |

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| | | **Day 6** Students draw thermal diagram and compare data from lab.<br><br>**Day 7** Assessment<br><br>**Resources**<br><br>Elephant Toothpaste demonstration<br><br>Energy change demonstrations and endothermic and exothermic student lab exploration<br><br>Animation that shows changes in energy for an exothermic and endothermic reaction<br><br>**Additional Resources:**<br>**ACT & SAT**<br>TN ACT Information & Resources<br>SAT Connections<br>SAT Practice from Khan Academy |

| **Chemistry Quarter 2 Curriculum Map** | | | | | |
|---|---|---|---|---|---|
| **Quarter 1** | | **Quarter 2** | **Quarter 3** | | **Quarter 4** |
| Unit 1<br>Atomic Structure | Unit 2<br>Interactions of Matter<br>Part I | Unit 3<br>Interactions of Matter<br>Part II | Unit 4<br>Interactions of Matter<br>Part III | Unit 5<br>Matter and Energy | Unit 6<br>Acid & Bases and Nuclear Chemistry |
| 5 weeks | 4 weeks | 9 weeks | 3 weeks | **6 weeks** | 9 weeks |
| Unit 3<br>Atomic Structures (Week) | | | | | |
| **Overarching Question(s)** | | | | | |
| How are waves used to transfer energy and information? | | | | | |
| **Unit, Lesson** | **Lesson Length** | **Essential Question** | | **Vocabulary** | |

| Unit 3<br>Interactions of Matter<br>Part I | 1 week | **Essential Questions**<br>● How is matter quantified?<br>● How does industry utilize stoichiometry to maximize production?<br>● How does society solve problems? | Moles, mass, percent yield, stoichiometry, limiting reactant, excess reactant, standard temperature and Pressure |
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| Standards and Related Background Information | Instructional Focus | Instructional Resources |
|---|---|---|
| **DCI**<br><br>CHEM1PS1: Matter and its Interaction<br><br>**Standard**<br><br>CHEM1.PS1.3 Perform stoichiometric calculations involving the following relationships: mole-mole; mass-mass; mole-mass; mole-particle; and mass-particle. Show a qualitative understanding of the phenomenon of percent yield, limiting, and excess reagents in a chemical reaction through pictorial and conceptual examples (states of matter liquid and solid; excluding volume of gasses).<br><br>**Explanation**<br><br>Standard 7.PS1.4 explores the idea that chemical reactions are rearrangements of atoms, and students undertake the process of balancing chemical reactions with that standard in seventh grade. The introduction of molar masses in high school makes an explicit connection between the number of atoms, as previously investigated, and the actual masses of the atoms, permitting the collection of more concrete evidence for the conservation of mass in chemical reactions.<br><br>**Misconceptions** | **Learning Outcomes**<br><br>● Convert among the following quantities of substance; mass, number of moles, number of particles, molar volume of gases.<br>● Identify and solve stoichiometry problems which interconnect volume of gases at STP, moles, and mass<br>● Calculate the percent yield in a word problem using a balanced chemical equation.<br>●<br>**Phenomenon**<br><br>Use a recipe for chocolate chip cookies and a list of the amount of each ingredient available to use. Students will analyze the recipe and ingredients and calculate which ingredient they will run out of first in making the cookies and how many cookies they can make using the given information. Help students identify which ingredient limits the number of cookies.<br><br>You could also use musical chairs to illustrate the concepts of limiting reactant and excess reactant. Chairs are the limiting reactant and students are the excess reactant | **Curricular Materials**<br><br>Engage<br><br>Explore<br><br>Explain<br><br>Elaborate<br><br>Evaluate<br><br>**Textbook**<br><br>Modern Chemistry Chap. 9<br><br>**Laboratory Activities/Investigations**<br><br>Modern Chemistry Chap. 9 Teacher Resources:<br><br>● Virtual Lab Determining the Limiting Reactant<br>● Gravimetric Lab Hard Water Testing<br>● Stoichiometry and Gravimetric Analysis<br>● Limiting Reactant in a Recipe<br>● Stoichiometry<br>**Simulations**<br><br>Modern Chemistry Chap. 9 Teacher Resources<br><br>● http://www.wisc-online.com/Objects/ViewObject.aspx?ID=GCH1504 |

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| Students often automatically pick as the limiting reactant the reactant that is present in the smaller amount. Advise students that to determine the limiting reactant, they must factor in the coefficients of the reactants in the balanced chemical equations.<br><br>**Science and Engineering Practice**<br><br>Developing and Using Models<br><br>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.<br><br>**Cross Cutting Concepts**<br><br>Systems and System Models<br><br>Students create and manipulate a variety of different models; physical, mathematical, computational. | | ● St.colorado.edu/en/simulation/reactants-products-and-leftovers<br>● Teacher Resource Sec 9.1<br>**Videos**<br><br>Why It Matters: Stoichiometry, Modern Chemistry Chap. 9 Sec. 1<br><br>**Articles**<br><br>Modern Chemistry Chap. 9 Teacher Resources:<br><br>● Student Edition: Chemical Technicians p. 290<br>● p. 292 The Case of Combustion<br>**Performance Tasks**<br><br>● Students will perform stoichiometric calculation using balanced chemical equations.<br>● Students will perform a stoichiometric lab.<br>● Students will perform a quick lab involving a cookie recipe and ingredients. P.306<br>● When given the limiting reactant students will calculate the percentage yield.<br>**Day 1** Review of mole to gram and gram to mole calculation<br>**Day 2** Review balancing equations. Use balanced equations to develop mole to mole ratios.<br>**Day 3** Practice mole to mole ratios<br>**Day 4** Use dimensional analysis to calculate converting moles of one reactant to moles of other reactant.<br>**Day 5** Practice mole to mole conversions. Include mole of reactant to mole of product and reverse.<br>**Day 6** Practice all types of mole to mole conversions.<br>**Day 7** Mole Ratios Lab<br>https://www.smc.edu/AcademicPrograms/PhysicalSciences/Documents/Chemistry_10_Experiments/Ch10_Stoichiometry.pdf<br>**Day 8** Introduce gram of reactant to mole of other reactant calculations<br>**Day 9** Practice gram to mole calculations and reverse. Introduce |

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| | | the use of products in these calculations.<br>**Day 10** Practice all types of gram to mole calculations and mole to gram calculations.<br>**Day 11** Introduce calculations for gram to gram of any species in an equation<br>**Day 12** Practice all calculations<br>**Day 13** Stoichiometry lab<br>https://www.flinnsci.com/api/library/Download/3d5adc3604544709a12cd976f8e41ca2<br>**Day 14** Introduce Limiting and Excess Reactants<br><br>**Day 15** Practice identifying limiting reactants.**Additional Resources:**<br>**ACT & SAT**<br>TN ACT Information & Resources<br>SAT Connections<br>SAT Practice from Khan Academy |

| Textbook Resources | DCIs and Standards | Videos | Additional Resources: |
|---|---|---|---|
| Textbook | DCI<br>**CHEM1.PS1:** Matter and Its Interactions<br><br>Standard | Khan Academy<br>Illuminations (NCTM)<br>Discovery Education<br>The Futures Channel<br>The TeachingChannel<br>Teachertube.com<br><br>**Simulations** | **ACT & SAT**<br>TN ACT Information & Resources<br>ACT College & Career Readiness Mathematics Standards<br>SAT Connections<br>SAT Practice from Khan Academy |