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 a meaningful curriculum 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 curriculum 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

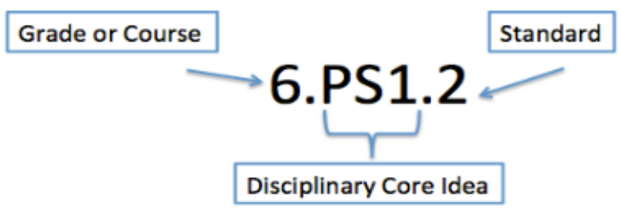
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain 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 defines 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.

SCS Physical Science Quarter 1 Curriculum Map

Unit 1 Matter	Unit 2 Chemical Reactions	Unit 3 Motion and Stability	Unit 4 Energy and Machines	Unit 5 Heat and Electricity	Unit 6 Nuclear Energy	Unit 7 Waves	Unit 8 Electromagnetic Radiation
5 weeks	4 weeks	9 weeks	3 weeks	4 weeks	2 weeks	4 weeks	5 weeks

UNIT 1: Matter [5 Weeks]

The Overarching Question(s)

- **What causes matter to change states? How does gas behave under different conditions?**

DCI, Standards, Explanations, Misconceptions Length [7 days]	Learning Outcomes/Phenomena (Anchor, Driving)	3-Dimensional Instructional Approach (SEP's & CCC's)
DCI PSCI.PS1: Matter and Its Interactions **Standards** PSCI.PS1.1 Using the kinetic molecular theory and heat flow considerations, explain the changes of state for solids, liquids, gases, and plasma. PSCI.PS1.2 Graphically represent and discuss the results of an investigation involving pressure, volume, and temperature of a gas. **Explanation** In the K- 8 grades, students learn that matter exists as different substances that have different observable properties which serve different purposes. The fact that matter exists as atoms, particles that cannot be seen with our eyes and molecules explains its properties. At the 9 – 12 level, students are expected to further develop their understanding of atoms and explain matter in more physical terms. The state of matter of a substance is dependent on three factors: the intermolecular attractions between the atoms/molecules of the substance, the external pressure on the substance, and the temperature of the substance. Some substances such as hydrogen and helium atoms exist	**Essential Questions** • How do particles move in the different states of matter? • How is a gas affected when pressure, temperature, or volume is change? **Learning Outcomes** • Distinguish among solids, liquids, gases, and plasmas. • Describe and illustrate the physical differences among solids, liquids, and gases in terms of their mass, volume, density, shape, and particle arrangement. • Explain the interrelationship between pressure, temperature, and volume of gases. • Solve Gas Laws problems. **Phenomenon** You may demo some of the dry ice experiments, let students explore, or use video to engage. Pose the following question: **Is it possible to have boiling ice water? If so, explain how. If not, why not?** Dry ice is usually a fascinating and fun material for your students. From making "fog" to "boiling in water," it is well-known for creating special effects.	**Science and Engineering Practice** 1. **Asking questions** Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. 2. **Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world, but have implications on the behavior of the modeled systems and can identify limitations of their models. **Crosscutting Concept** 1. **Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. 2. **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.

primarily as gasses due to very weak intermolecular attractions. This contrasts with substances such as ionic compounds which have extremely strong intermolecular attractions keeping atoms in a very organized crystal lattice pattern even at high temperatures. Pressure can be seen as an external force from surrounding matter pushing the particles closer together. Use phase change diagrams during discussions of this standard. (Students are not expected to differentiate between the types of intermolecular attractions, merely to recognize their role in substances moving between states of matter.) When exploring the behavior of gases, it is important to consider experimental design. Experiments used to show the relationships between these sets of variables should include one independent and one dependent variable. Other variables should be held constant. Pressure should serve as the dependent variable because it cannot be manipulated directly. Individual demonstrations can be performed to explore each of the different gas laws. **Misconceptions** Ask students to define matter. Answers will vary, but some students may indicate that matter is anything that has mass and takes up space. Ask students how the different states of matter compare. Answers will vary. Use student responses to identify misconceptions about the topic. For example, many students may think that gases of a particular substance are not composed of the same particles as the solid of that same substance.	Carbon dioxide, however, also has fascinating and very useful chemical properties. At room temperature and pressure, solid carbon dioxide will warm to –78 °C and then begin to sublime to carbon dioxide gas. The carbon dioxide gas is, initially, also at –78 °C, which causes moisture in the air to condense and form the characteristic fog that dry ice is famous for. One interesting feature of carbon dioxide is that at atmospheric pressure, it only exists as a solid or gas. In order to exist as a liquid, carbon dioxide must be subjected to a pressure of at least 5.11 atmospheres. Most chemicals will exist as a solid, liquid, or gas depending on temperature and pressure. This relationship between phase, pressure, and temperature can be presented graphically in the form of a phase diagram. https://www.flinnsci.com/api/library/Download/cc3f4560edb447c693d6ad631f971ff3 What is dry ice? Chief Scientist Carl Nelson teaches what dry ice is and what you can do with it. https://www.youtube.com/watch?v=oVmIAqwgIRo Safety Tip: Correct Way to Store Dry Ice https://www.youtube.com/watch?v=RK8u2c6FJbY 8 Cool Dry Ice Experiments https://www.youtube.com/watch?v=yrN05YdYigw Do not do the last experiment in the school setting!!! --- The Science Teacher's Activity-A-Day Book 1.1 Boyle's Gas Law Marshmallow Under Pressure p. 3 Materials Needed: Large Plastic Syringe (without a needle), Large Marshmallow, and a Black Sharpie or Felt-tip Pen You may also use a plastic syringe that will fit a mini marshmallow. If you don't have this book, then use Flinn Scientific: The Expanding Marshmallow https://www.flinnsci.com/api/library/Download/eea8dce150cd46a88bbfcab58b	

	b7572f or Experiments with a 140 mL Syringe http://www.chymist.com/Exps%20with%20a%20140%20mL%20syringe.pdf Explanation: Gases expand to fill their containers. When you pull the plunger of the syringe this creates a low pressure inside the syringe (a vacuum). The marshmallow fills with air. Under reduced pressure, the air expands to fill the syringe and causes the marshmallow to increase in size. When the marshmallow is removed from the syringe, you may observe that the marshmallow is smaller in size than when you started. This is a result of air escaping from the marshmallow. The marshmallow is slightly deflated. ____ Show picture of the railroad tank car. Scenario: The inside of this tank car was steam cleaned, and then all vents and hatches were closed. The employees went home for the night. Pose the question, “What do you think happened next?” or “What did the employees find when they returned to work the next morning?” Show a picture of the collapsed railroad tank car. Show the video clip. This happens when you don't properly vent a storage tank https://www.youtube.com/watch?v=2WJVHtF8GwI&feature=youtu.be Student journaling/ Individual brainstorm: What was happening inside of the tanker or outside of the tanker that made it crush? Why did the tanker crush? How did the tanker crush? If it helps, think about “before” and “after” and draw a diagram. Read the post “**Revisiting the Can Crush Lab: Using the Practices to Investigate a Phenomenon”** http://www.negaresa.org/science/?p=337 to understand how the three dimensions of science connect through this phenomenon. Lesson resources are also provided. The phenomenon of the collapsing tanker provides a real-world, anchor for the lesson and drives student learning toward a meaningful goal.	

Vocabulary

Boiling point, kinetic theory, heat of fusion, heat of vaporization, melting point, condensation, evaporation, phase change, sublimation, deposition, plasma, thermal expansion, pressure, buoyancy, Charles's Law, Boyle's Law

Curricular Materials

Glencoe Physical Science
Chapter 14 – Solids, Liquids, and Gases

14.1 Matter and Thermal Energy

Phase Change Lab p. 440 Students will heat ice and graph the temperature changes over time. They will observe the thermal energy changes that occur as matter goes from the solid to the gas state.

Vernier – Activity # 3 -Freezing and Melting of Water https://www.vernier.com/experiments/psv/3/freezing_and_melting_of_water/
http://www2.vernier.com/sample_labs/PSV-03-LABQ-freeze_melt.pdf

Teacher's Pet
Phase Diagrams Video https://www.youtube.com/watch?v=zn8MzCiVCCc
Liquids and Solids Video https://www.youtube.com/watch?v=YN3MVNXHbYg

14.2 Properties of Fluids

Mini-Lab Relate Density and Buoyancy p. 442 Students will investigate the properties of density and buoyancy.

Related Article: Eureka! The Archimedes Principle
By Rachel Ross, Live Science Contributor | April 25, 2017 08:57pm ET
https://www.livescience.com/58839-archimedes-principle.html

Activity: Cartesian Divers Flinn Scientific https://www.flinnsci.com/api/library/Download/e3467797ed574c1ea3aeb05ba06466a2
Cartesian divers are great toys that can be used to teach important science concepts. Several variations of Cartesian divers are on the market. Imagine that you and your classmates are members of a research and development team at a toy company and are challenged to design a new Cartesian diver toy. Can you design a toy that includes at least three divers that will descend and ascend in a particular order?

14.3 Behavior of Gases

Virtual Lab Boyle's Law – What factors influence the pressure of a gas?
http://www.glencoe.com/sites/common_assets/science/virtual_labs/PS08/PS08.html

Solve Gas Law Problems
Mini-Lab Observe Pressure p. 450

How Science Works – Detecting Dark Matter p.454 This is a good example of how scientific knowledge is a work in progress.

Article: SCUBA Diving and Gas Laws by Polly Dornette https://www.carolina.com/teacher-resources/Interactive/scuba-diving-and-gas-laws/tr29802.tr

Stop at the end of the Charles's Law section

Teacher's Pet
Gas Laws Video https://www.youtube.com/watch?v=Osq71Y82uac
Gases and Gas Laws Video https://www.youtube.com/watch?v=0cnelAlE2vY

Performance Task
Soda Can Investigation - After developing initial models, students collect and analyze key evidence during the Soda Can Investigation. In the Soda Can Investigation, students implode an empty aluminum can to determine the cause of the implosion by relating the macroscopic observations to microscopic gas behaviors. After a targeted reading and class discussion, students return to revise their models created when the Collapsed Railroad Tanker phenomenon was introduced to the class. The Soda Can Investigation can be found in the post "**Revisiting the Can Crush Lab: Using the Practices to Investigate a Phenomenon"** http://www.negaresa.org/science/?p=337.

The Overarching Question(s)		
How is matter classified?		
DCI, Standards, Explanations, Misconceptions **Length [5 days]**	**Learning Outcomes/Phenomena (Anchor, Driving)**	**3-Dimensional Instructional Approach** **(SEP's & CCC's)**
DCI PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS1.3 Construct a graphical organizer for the major classifications of matter using composition and separation techniques. PSCI.PS1.4 Apply scientific principles and evidence to provide explanations about physical and chemical changes. **Explanation** In seventh grade, students learn that pure substances include both elements and compound and that the concept of mixtures includes both mixtures of elements and compounds. This standard indirectly builds on	**Essential Questions** • How are elements and compounds identified? • What are physical and chemical properties? • What are the differences and similarities of physical and chemical changes? • How does the law of conservation of mass apply to chemical changes? **Learning Outcomes** • Distinguish between examples of common elements and compounds. • Identify substances and mixtures based on physical properties. • Use the properties of selected materials to categorize them into groups. • Compare and contrast physical and chemical changes. • Compare different types of mixtures. • Construct an experiment to separate the components of a mixture. **Phenomenon**	**Science and Engineering Practice** **1. Asking questions** Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **2. Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world, but have implications on the behavior of the modeled systems and can identify limitations of their models. **Crosscutting Concept** **1. Patterns** Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations

the idea that chemicals have specific properties. When elements/compounds exist in a mixture, each of the parts retains its unique physical properties. In the event of a reaction within this mixture, a pure substance can result (assuming perfect ratios of constituent parts). This new pure substance will have a new set of physical properties (e.g., boiling point, state of matter at room temperature, conductivity). At the 9 – 12 level, build upon this knowledge by using graphical organizers and strategies that allow students to apply these scientific principles and provide explanations about the phenomena that they encounter. Students now explore the use of these physical and chemical properties to separate mixtures. At the Chemistry level, students analyze the substances to aid in further discussion and facilitate further quantitative analysis. **Misconceptions** **Definition of Compounds** Students might think that elements made from more than one atom, such as H_2, Cl_2, P_4, and S_8, are compounds. However, compounds must be made from combinations of different elements. **Physical and Chemical Changes** Students may develop the idea that physical and chemical changes are mutually exclusive and that every observable change is easily classified as one or the other. In fact, the distinction is not always so clear. Students should understand that many chemical changes involve physical changes as well.	See Teacher Edition p. 461 Introduce the Chapter - Properties of Matter, Big Idea - Compounds and Molecules, and Use the Photo - Elements **Sample 1** Article: Salar de Uyuni: The science behind Bolivia's salt flats DATE: 24 JUN 2016 BY: GO AHEAD TOURS https://travelblog.goaheadtours.com/salar-de-uyuni-bolivias-salt-flats/ Show video clip or Use a photo Weird Wonder: Salar de uyuni https://www.youtube.com/watch?v=IYMPF30mdAE Reflections from Uyuni https://www.youtube.com/watch?v=_LJ62r7sIj8 WORLD'S BIGGEST MIRROR | Uyuni Salt Flats, Bolivia https://www.youtube.com/watch?v=1vPMD3wmaZo **Sample 2** Launch Lab Distillation of Water p. 460 or Video about Distillation of Water Connect to Memphis or Tennessee Distilleries Meet Old Dominick's Head Distiller https://www.youtube.com/watch?v=m211mGc2ZKM The Tennessee Whiskey Trail Launch - June 2017 https://www.youtube.com/watch?v=1_eRSDjCt0I https://www.youtube.com/watch?v=0qj_VXtPiqI How distilling works? What does a distiller do? Jobs and Salaries? What products are made in a distiller? How do these products impact our economy? Make a connection to biology and the study of fermentation.	

	Sample 3 Show students the picture of the Refinery Distillation Towers and ask them what do they think happens at the place pictured. Poll the class to determine if they know what products come from raw crude oil. List the products that they mention on the board or chart paper.  Student journaling / Individual brainstorm: How do chemical engineers purify various hydrocarbons such as natural gases, gasoline, diesel, jet fuel, lubricating oils, asphalt, etc., from raw crude oil? After students have finished their writings, reveal that this is a picture of Refinery Distillation Towers. Allow students to jot down questions that they may have. Use student questions to drive lessons. Suggestion: Teacher should read the Separating Mixtures lesson at the following site. https://www.teachengineering.org/lessons/view/uoh_sep_mixtures_less1	

Vocabulary

Pure substances, element, atom, compound, heterogeneous mixture, homogeneous mixture, solution, suspension, colloid, physical property, viscosity, conductivity, malleability, melting point, boiling point, filtration, distillation, physical change, chemical property, flammability, reactivity, chemical change, precipitate, law of conservation of mass

Curricular Materials

Glencoe Physical Science
Chapter 15 – Classification of Matter

15.1 Composition of Matter

Mini-Lab Separate Mixtures p. 465

Virtual Lab Properties of Matter – How can a type of material be identified by its type of material be identified by its physical and chemical properties?
http://www.glencoe.com/sites/common_assets/science/virtual_labs/BL01/BL01.html

15.2 Properties of Matter

Quick Demo Chemical Change p. 470 A beaker is held over a burning candle for a few minutes. Students answer the question, "What clues indicate that a chemical change has taken place?"

Property Changes BrainPOP

Virtual Lab Changes of Matter - How are physical and chemical changes distinguished?
http://www.glencoe.com/sites/common_assets/science/virtual_labs/E03/E03.html

Demonstration – Solubility of Dyes p. 471 Purpose: To separate a mixture by a physical property or have students to conduct an Ink Chromatography Lab. Students use paper chromatography to separate pigments in ink samples and calculate the retention factor for the ink samples. https://www.msichicago.org/fileadmin/assets/educators/learning_labs/documents/ink_chromatography.pdf
Flinn Chromatography Challenge – Students reproduce beautiful, multicolor art patterns using paper chromatography! The challenge is to duplicate the pattern—to decide which pens were used and how they were applied to the paper. https://www.flinnsci.com/api/library/Download/d2f155e6402147a6849d7769ff848754

Distillation of Water Video Lab

Identity Changes Mini-Lab p. 473 Students observe and determine chemical and physical changes.

Science Journal – Chemical Changes in Daily Life p. 473

Quick Demo Chemical Properties p. 474 Students observe the interactions between two relatively new pennies (1 has the edge filed to expose the interior zinc metal) and 1M hydrochloric acid. Point out how the difference in chemical properties could be used to separate copper from zinc.

Quick Demo Physical and Chemical Changes p. 475

Performance Task
Law of Conservation of Mass Lab p. 478 – 479 Question: Is the mass of antacid tablets conserved after they are dissolved?
Students will design an experiment to observe the law of conservation of mass. Students can design their experiments to compare initial and final masses of an open and closed system to make this an inquiry lab. Students can also research the chemical reactions involved when antacids are used to neutralize excess stomach acid.

Additional Resource
The Properties of Matter Virtual Lab

https://my.hrw.com/sh2/sh07_10/student/flash/virtual_investigations/hst/mat/hst_mat_vi.html

Elements, Compounds, and Mixtures Virtual Lab
https://my.hrw.com/sh2/sh07_10/student/flash/virtual_investigations/hst/mix/hst_mix_vi.html

Teacher's Pet Matter Video
https://www.youtube.com/watch?v=ASMnfoe1Q-g&t=153s

Elements, compounds and mixtures activity along with a poem that teaches the concept **http://www.evanschemistrycorner.com/WS/MatterWS/WS1-7-2_Elements_Compounds_and_Mixtures.pdf**

Students observe and compare an element, compound and mixture. In this elements, compounds and mixtures lesson plan, students observe taco salad, a beaker of salt and a helium balloon. Students make lists comparing and contrasting the three samples. They identify the 3 samples as an element, compound and mixture. Students experiment with nuts, bolts and washers to represent elements, compounds and mixtures. http://www.lessonplanet.com/teachers/lesson-plan-elements-compounds-and-mixtures--2

The Overarching Question(s)

How are atoms and elements differentiated? How is the periodic table used?

DCI, Standards, Explanations, Misconceptions Length [13 days]	Learning Outcomes/Phenomena (Anchor, Driving)	3-Dimensional Instructional Approach (SEP's & CCC's)
DCI PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS1.5 Trace the development of the modern atomic theory to describe atomic particle properties and position. PSCI.PS1.6 Characterize the difference between atoms of different isotopes of an element. PSCI.PS1.7 Use the periodic table as a model to predict the relative properties of elements. **Explanation** Ultimately, understanding of the sub-structure of atoms will allow Chemistry I students to understand causes for intermolecular attractions	**Essential Questions** • What is the electron cloud model of the atom? • What are isotopes? • How is the periodic table organized and used to predict the properties of elements? **Learning Outcomes** • List the three major subatomic particles and distinguish among their location, charges, and relative masses. • Identify the number of protons, neutrons, and electrons in an atom of an isotope based on its atomic number and atomic mass. • Use the periodic table to identify the characteristics and properties of metals, metalloids, and nonmetals. • Create a classification system using the properties of selected elements and compare it to the periodic table. • Identify the number of protons, neutrons, and electrons in an atom of an isotope based on its atomic number and atomic mass.	**Science and Engineering Practice** **1. Asking questions** Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **2. Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world, but have implications on the behavior of the modeled systems and can identify limitations of their models. **Crosscutting Concept** **1. Patterns** Different patterns may be observed at each of the scales at which a system is studied and can

as well as bonding and the implications of these phenomena. In fifth grade, students observed some of these phenomena including dissolving solids and phase changes. In seventh grade, that foundation is reinforced more and discussion about the relevant historical models include Thomson's plum pudding model to explain the behavior of electrons and ion formation and the work of Rutherford and Bohr to explain nuclear developments and structures descriptions of isotopes. At this level, students should understand the difference between atoms and isotopes of the same atom, electron cloud structure and electron dot diagrams. At the Chemistry I level, students are expected to demonstrate a deeper understanding of the historical models of the atom. As students use the periodic table, they are expected to understand patterns leading to the arrangement of the periodic table or 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. **Misconceptions** **Atomic Structure** Students often do not understand that atoms consist mostly of empty space. If the nucleus of an atom were the size of a marble then the first electron level would be about a half mile or 0.8 km away from the nucleus. **Periodic Table** Students should understand that Mendeleev was at a disadvantage when he created his periodic table. He did not have knowledge of the atomic structure. Electrons were not discovered until the late 1890s. His chart was based on mass and properties of the elements. **Conductivity and Temperature** Students might think that electrical conductivity is independent of temperature or that it increases as temperature increases. Explain that conductivity in metals generally decreases as temperature decreases.	**Phenomenon** **Launch Lab – Hidden Information p. 486 TE** Much of the fun of receiving a wrapped gift is trying to figure out what's inside before you open it. Chemists have had similar experiences trying to determine the structure of the atom. How good are your skills of observation and inference? Explain observation and inference if you have not previously covered. Teacher's Pet Observations and Inferences Video https://www.youtube.com/watch?v=fBlR7taW9jk Have students to follow the procedure. Complete the Oral Assessment. Introduce the Chapter p.487 Tie to Prior Knowledge p. 488 Discuss Main Idea p. 488 **How can we color a flame?** For the anchor phenomenon you may have students to complete the Launch Lab on p. 516 or do it as a demo. If you do not have the materials available in your lab, then you may show one of the video clips. It is the distinct properties of each element that identify one element from another. Heated atoms of some elements absorb energy and then release the absorbed energy, which you see as colored light. Experiment: 5 colored flames (How to color fire with salts) https://www.youtube.com/watch?v=faHuLlfzQfg Experiment of the Month: Colorful Fire https://www.youtube.com/watch?v=nPcrvc0oKbc A Safer "Rainbow Flame" Demo for the Classroom	provide evidence for causality in explanations of phenomena.

	https://www.youtube.com/watch?v=kkBFG1mTSBk Have students to answer the Think Critically Questions. • Is chlorine or strontium responsible for strontium chloride's flame color? Explain. • Make a plan to determine whether copper or sulfate was responsible for the flame color of copper (II) sulfate. Introduce the chapter p.517 Tie to prior knowledge p. 518	

Vocabulary

Atom, nucleus, proton, electron, electron cloud, neutron, quark, atomic number, mass number, isotope, energy levels, electron cloud, orbital, electron dot diagram, average atomic mass, periodic table, period, group, ductile, malleable, metal, metallic bonding, radioactive element, transition element, diatomic molecule, nonmetal, allotrope, metalloid, semiconductor, transuranium element, valence electron, alkali metals, alkaline earth metals, halogens, noble gases, transition metals

Curricular Materials

Glencoe Physical Science
Chapter 16 – Properties of Atoms and the Periodic Table

16.1 Structure of the Atom

Quick Demo Gathering Evidence p.490

Atomic Model BrainPOP

Visualizing the Early Atomic Models p. 492
https://www.scribd.com/document/352194045/The-History-of-the-Atom-Theories-and-Models

Activity – Have students to research one of the scientists responsible for our understanding of the structure of the atom throughout time and write a paragraph about the scientist's early years. What experiences led to his interest in science? Was he the first in his family to be interested in science? What subjects did he study in school? Have students to write brief reports in their science journals.

Challenge – Have students to research models used in other fields. Have students to bring in models of their choice and present them to class, explaining how the models are used by scientists and engineers in their selected fields.

Quick Demo - Modeling Atoms p.495

16.2 Masses of Atoms

Integrating Life Science – Carbon Dating p.496

Apply Science – How Can Radioactive Isotopes help tell time? p. 496

16.3 The Periodic Table

Virtual Lab Periodic Table – How is an atom's structure related to its position on the periodic table?
http://www.glencoe.com/sites/common_assets/science/virtual_labs/E19/E19.html

Article - Scientific American -The Evolution of the Periodic System https://www.scientificamerican.com/article/the-evolution-of-theperiodic-system/
Students will read the article on the Evolution of the Periodic System and construct a timeline of the people and their contribution to the discovery of elements and where those elements are currently located on the periodic table.

Mini- Lab Organize Elements p. 499

Activity - Periodic Table Mystery https://www.carolina.com/teacher-resources/Interactive/periodic-table-activity/tr10839.tr
Objective: Using coded symbols for the main group elements in the first 4 periods of the periodic table, students will generate a periodic table from pertinent clues. They will use their knowledge of physical properties and periodic properties to predict the missing properties of several elements based on the elements' locations in the table.

Demonstration p. 501

Mini-lab Model an Aluminum Atom p.503

How Science Works – Cassini-Huygens Mission

Teacher's Pet Atoms Video https://www.youtube.com/watch?v=U_O0vL5e62o

Performance Task
Lab – A Periodic Table of Foods p. 507 Question: How does organizing your favorite foods to create your own periodic table resemble the task that Mendeleev took on?
Students will create a periodic table to organize foods. Have references available so students can find nutritional content of foods, such as fruits, that have no labels. Construct a bulletin board of the periodic tables of foods created by the class (es). Discuss why tables are or are not similar. Students might want to use a spreadsheet program to determine the layout of the class periodic table of foods for the bulletin board.

Lab - Properties of Elements p. 508 – 509 Question: Does a pattern emerge that appears to be based on the arrangement of elements in the periodic table?
Students will use the physical and chemical properties of unknown elements to classify and organize them into their own periodic table.
Periodic Trends and the Properties of Elements Laboratory Kits by Flinn Scientific help students identify trends in the reactions and solubility of alkaline earth metals. Identifying periodic trends is essential to understanding the periodic table.

Chapter 17 – Elements and Their Properties

17.1 Metals

Virtual Lab Elements - What properties do elements have? http://www.glencoe.com/sites/common_assets/science/virtual_labs/E21/E21.html
Handout - http://www.sps186.org/downloads/attachments/50293/Virtual%20Lab%20-elements%20on%20periodic%20table.pdf
Students will compare and contrast the properties of elements and identify elements based on their properties.

Integrate History – Metal Use Research p. 519

Integrate Health – Sodium p. 520

Quick Demo – Magnesium p. 521 Students will observe why magnesium has practical use in flares and fireworks.

Research – How calcium helps provide nutrients to crops.

Mini-Lab Discover What's in Cereal p. 522 Students will collect iron from cereal.

Inquiry Lab – Conductivity p. 523 Students will learn about conductivity in metals.

Integrate Career – Mining Engineer p. 524

17.2 Nonmetals

Elements in the Body Activity p. 526 Students research elements that are important to the human body to determine the purpose the element serves. Have students to present the information to the class in a creative way.

Demonstration – Isolate Hydrogen p. 527 TE

Integrate Career – Atmospheric Scientist p. 528 TE

Integrate Environment – Chlorofluorocarbons p. 528 TE

Mini-Lab Identify Chlorine Compounds in Your Water p. 529 Students determine the presence of chlorine compounds in drinking water. If you do not have the silver nitrate solution to do this lab, then you may use the resources below to create an activity for your students that have a real-world application.
Chlorine Residual Testing Fact Sheet from the CDC https://www.cdc.gov/safewater/publications_pages/chlorineresidual.pdf
TECHNICAL NOTES ON DRINKING-WATER, SANITATION AND HYGIENE IN EMERGENCIES - Measuring chlorine levels in water supplies from the World Health Organization
http://www.who.int/water_sanitation_health/emergencies/WHO_TN_11_Measuring_chlorine_levels_in_water_supplies.pdf
Article - Chlorination of Drinking Water from the Water Research Center https://www.water-research.net/index.php/water-treatment/tools/chlorination-of-water
How is water treated to make it suitable for drinking? Treating Our Water – This handout describes the drinking water treatment process.
https://www.epa.ie/media/Lesson%204%20Treating%20Our%20Water.pdf

Metals and Nonmetals Lab p. 531 Students will observe properties of metals and nonmetals and use their observations to classify the substances.

17.3 Mixed Groups

Apply Science p. 536

Visual Learning Figure 21 p. 537

Activity Song p. 537 Students write a song about an element, its discovery, and its uses and perform for the class.

Activity Synthetic Isotopes p. 538 - Students identify the isotopes of their assigned synthetic elements and the half-lives of the isotopes. Students compile information into a class table.

How Science Works – The Power or Peer Review p. 542

Teacher's Pet Periodic Table Video https://www.youtube.com/watch?v=_2JI7tz4blk

Performance Task
Carbon Allotropes Lab p. 540 – 541 Question: What gives graphite the slippery property of a lubricant and diamond its hardness? How do certain arrangements of atoms in a material relate to the material's properties? Students will make a working model of the layered graphite structure and use the model to determine the cause-and-effect relationship of the bonding between carbon atoms in graphite and graphite's physical properties. They will also make a model of diamond and investigate diamond's hardness.

The Gas That Glows
Students read about the history, properties, and use of Neon from a book or website. http://www.chemistryexplained.com/elements/L-P/Neon.html https://www.britannica.com/science/neon-chemical-element https://www.webelements.com/neon/

Use a creative way for students to demonstrate what they have learned about the element. For example, students can write a Haiku poem, acrostic poem, or complete a Four Squares chart. Divide students into groups of three. As a group, students will brainstorm a new product or business, and then design a neon sign to advertise their idea. Groups do a Gallery Walk using sticky notes to see if they can correctly guess what the other groups' signs represent.

Students read a current event about neon.
Science Daily Article Date: August 12, 2016 - Scientists capture neon in an organic environment for the first time https://www.sciencedaily.com/releases/2016/08/160812160457.htm
Science Daily Article Date: October 28, 2016 - Extinguishing a fusion fire in a flash of light https://www.sciencedaily.com/releases/2016/10/161028115109.htm

Project Idea – Develop an original use for a new material, design "blueprints," conduct a patent search, and present your idea to fellow scientists in your class.

SCS Physical Science Quarter 1 Curriculum Map

Unit 1 Matter	Unit 2 Chemical Reactions	Unit 3 Motion and Stability	Unit 4 Energy and Machines	Unit 5 Heat and Electricity	Unit 6 Nuclear Energy	Unit 7 Waves	Unit 8 Electromagnetic Radiation
5 weeks	4 weeks	9 weeks	3 weeks	4 weeks	2 weeks	4 weeks	5 weeks

UNIT 2: Chemical Reactions [4 weeks]

The Overarching Question(s)		
How are atoms and elements differentiated? How is the periodic table used? What are the different types of chemical reactions?		
DCI, Standards, Explanations, Misconceptions **Length [7 days]**	**Learning Outcomes/Phenomena (Anchor, Driving)**	**3-Dimensional Instructional Approach** **(SEP's & CCC's)**
DCI PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS1.8 Using the patterns of electrons in the outermost energy level, predict how elements may combine. PSCI.PS1.9 Use the periodic table as a model to predict the formulas of binary ionic compounds. Explain and use the naming conventions for binary ionic and molecular compounds. **Explanation** The concepts addressed in the above standards 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	**Essential Questions** • How does a compound differ from its component elements? • What does a chemical formula represent? • How do electron dot diagrams help predict chemical bonding? • Why does chemical bonding occur? • What are ionic bonds and covalent bonds? • Which particles are produced by different types of bonding? • How do nonpolar and polar covalent bonds compare? • How do you balance a chemical equation? • How do electron dot diagrams help predict chemical bonding? • Why does chemical bonding occur? • How are oxidation numbers determined? • How are formulas written for ionic and covalent compounds? • How are ionic and covalent compounds named? **Learning Outcomes** • Use information about an element's position in the periodic table to determine the charge of its ions.	**Science and Engineering Practice** **1. Asking questions** Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **2. Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world, but have implications on the behavior of the modeled systems and can identify limitations of their models. **Crosscutting Concept** **1. Patterns** Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations. **5. Energy and Matter**

uncover these patterns. All bonds in compounds represent some form of electromagnetic (electrostatic attraction). The difference between bond types is related to the cause for the electrostatic attraction, whether or not atoms are ionized when they interact. Students use the periodic table to predict how elements may combine due to their positions. Also, students learn to name ionic and covalent compounds and how to write chemical formulas. The concepts above are important because it prepares students for understanding concepts in chemistry. Students will discuss orbital notations in chemistry and the discussion relates back to the organization of the periodic table and the arrangement of elements in the periodic table. **<u>Misconceptions</u>** **Roman Numerals** The use of Roman numerals can be confusing. Copper (II) oxide is CuO, with one copper atom for each oxygen atom. The compound copper (I) oxide is written as Cu_2O, with two copper atoms for each oxygen atom. Remind students that the Roman numeral represents the charge on an atom, and the Arabic subscript numbers, such as 2 and 3, show the number of atoms of each element.	• List the three major subatomic particles and distinguish among their location, charges, and relative masses. • Know the chemical symbols for the common elements. • Use the periodic table to identify the characteristics and properties of metals, non-metals, and metalloids • Label a periodic table with oxidation numbers of main group elements, identify elements likely to form ions and use information to construct formulas for compounds • Explain ionic and covalent bonding based on the oxidation numbers of the elements in a compound. **<u>Phenomenon</u>** **Why did the Statue of Liberty turn green?** It's green because the copper has corroded, and the simple salts of copper that have formed are blue-green. The copper reacted with the air and produced copper salts, which some people called corrosion products or tarnish. When copper is exposed to the air for long periods of time and without anyone handling it like this, that's what happens. And the color of the salts or corrosion products is green. **See Figure 1** on page 552 in **Glencoe Physical Science Teacher Edition.** **How does potassium iodide look and what can it be used for?** Potassium iodide is a stable, white solid that looks like table salt. Potassium is very reactive with water, silver in color, soft, and a metal. Iodine is a dark gray solid that sublimates into a purple gas. **See Figure 2** on page 553 in **Glencoe Physical Science Teacher Edition.** Potassium iodide (KI) is a chemical compound that can be used to protect the thyroid gland from possible radiation injury caused by radioactive iodine (radioiodine). **Visual Learning – Energy Levels (McGraw Hill Connect ED)** **https://connected.mcgraw-hill.com/c2j/resourceLibrary.do?bookId=MPF89YHKZK8ZBF6PR4OTWJKCE1&mode=SEARCH&searchTerm=visual+learning+electron+energy+levels** **Why is Iodized salt an important nutrient?** It provides iodine in the diet. Iodine is necessary for making thyroid hormone and is often lacking in the diets of people who live inland and don't get much seafood (the ocean contains iodine, in the form of iodide compounds, and so seafood does to). Some areas of the world have soil that is very low in iodine, and people living in those areas used to suffer from goiters (enlargements of the thyroid gland) and cretinism (retardation of growth and mental	Students demonstrate and explain conservation of mass and energy in systems, including systems with inputs and outputs.

	development due to thyroid hormone deficiency). Iodized salt prevents this. **See Figure 7** on page 558 in **Glencoe Physical Science Teacher Edition.**	

Vocabulary
chemical bond , chemical formula , covalent bond , ion, ionic bond, molecule, anion, cation, nonpolar bond, nonpolar molecule, polar bond, polar molecule, binary compound, hydrate, oxidation number, polyatomic ion

Curricular Materials

Glencoe Physical Science Teacher Edition
Chapter 18 – Chemical Bonds

<u>18.1 Stability in Bonding</u>

Review Main Idea – Elements and Compounds p. 552.

Chemical Bonds Discussion (Similar Formulas), p. 553.

Caption Question p. 553. In-Text Question, p. 553.

Khan Academy Video on Bonding
https://www.khanacademy.org/science/biology/chemistry--of-life/chemical-bonds-and-reactions/v/ionic-covalent-and-metallic-bonds

<u>18.2 Types of Bonds</u>

Visual Learning (Figure 8) p. 559.

Activity- has students find potassium and iodine on the periodic table. How many electrons does potassium have? How many electrons does iodine have? Have students count the number of electrons in figure 8. Explain how the electrons allowed on each energy level.

Challenge- Caption Question Figure 8 p. 559.
number

Discussion (Atom Identity & Electron Moves), p. 559.

Complete the Activity on Ionic Bonds p. 560

Activity – Ionic Bonds Review

This is a review activity for ionic bonding. PowerPoint to be used as hand outs. Students are given a "dating card" each which gives an element and some information about them. Students need to "speed date" with each other to find another element (or elements) to form a bond with in order to make a compound. Wrap up- certificate sheet. Students given a certificate of bonding sheet; they must draw a dot and cross diagram for the compound they made as well as explain in terms of electrons/oxidation states why they decided to make this compound. http://www.sharemylesson.com/teaching-resource/Ionic-bond-speed-dating-6087374/

PHet simulation- building an atom: https://phet.colorado.edu/en/simulation/build-an-atom

18.3 Writing Formulas and Naming Compounds

Practice Problems 14-16; p. 567.

Caption Question p. 571.

Section Review p. 571.

Khan Academy Video on Writing Formulas and Naming Compounds
https://www.khanacademy.org/science/chemistry/atomic-structure-and-properties/introduction-to-compounds/v/naming-ions-and-ionic-compounds

Photographic Periodic Table: A great visual of what the elements actually look like in real life: http://www.periodictable.com/

Powerpoint on the four types of chemical bonds Videos and Scientific American articles on chemical bonding:
https://www.nbclearn.com/portal/site/learn/chemistry-now/how-atoms-bond

Students will write a paragraph about Mendeleev's periodic table. Students will use their paragraph to convince a reader that the periodic table is extremely useful to scientists. *(Hint: Use specific facts to support your argument.)* **Concepts in Action – Elemental Friends and Foes – Prentice Hall**

The following website describes molecules and compounds, provides examples, and has links to other interesting pages, such as 3-D models of molecules:http://www.edinformatics.com/math_science/compounds_molecules.htm

Atoms, Elements, Compounds and Mixtures Video
https://www.khanacademy.org/science/chemistry/atomic-structure-and-properties/modal/v/elements-and-atoms

Try this javascript test to assess your knowledge -- physical change or chemical change? http://www.edinformatics.com/math_science/a_p_chem.htm

Teacher Resources Site
http://education.jlab.org/indexpages/teachers.html

Chemical nomenclature – Khan Academy
https://www.khanacademy.org/science/chemistry/atomic-structure-and-properties/introduction-to-compounds/v/naming-ions-and-ionic-compounds

Students work in small groups to learn about the chemical composition of common substances using the American Chemical Society website.
http://www.discoveryeducation.com/teachers/free-lesson-plans/elements-of-chemistry-compounds-and-reactions.cfm

Performance Task
Checking for understanding. Logical-Mathematical. Have students read labels of various products and find five compounds that have names with numeric prefixes. Have them write out the formulas for each of these compounds. Reteach – Prefix. Ask students why calcium chloride ($CaCl_2$) is named without using the prefix system shown in Table 6 (p.570)
While carbon tetrachloride (CCl_4) does use a prefix to designate the number of chlorine atoms. Answer – the prefix system is used for covalent compounds. $CaClO_2$ is ionic.

Performance Task
The common name for $Na_2B_4O_5(OH)_4 – 8H_2O$ is borax. It is used as a washing powder. Ask students to determine the number of oxygen atoms in the molecule.

Performance Task
Active Reading/Reflection – Have students identify what they learned from activities. Then divide sheets of paper into several columns and record their thoughts under headings such as *"What I Did," What I Learned," "Questions I Have," "Surprises I Experienced, and "Overall Response."* Have students write a Reflective Journal for writing formulas.

The Overarching Question(s)		
How are atoms and elements differentiated? How is the periodic table used? What are the different types of chemical reactions?		
DCI, Standards, Explanations, Misconceptions Length [8 days]	**Learning Outcomes/Phenomena (Anchor, Driving)**	**3-Dimensional Instructional Approach (SEP's & CCC's)**
DCI PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS1.10 Develop a model to illustrate the claim that atoms and mass are conserved during a chemical reaction (i.e., balancing chemical equations). PSCI.PS1.11 Use models to identify chemical reactions as synthesis, decomposition, single-replacement, and double-replacement. Given the reactants, use these models to predict the products of those chemical reactions. **Explanation** Chemical reactions are rearrangements of atoms that follow predicable patterns. There are patterns both at the macroscopic level in the behavior of some of the reaction classes, as well as patterns in the rearrangements	**Essential Questions** • What are the reactants and products in a chemical reaction? • Is mass conserved in a chemical reaction? • Why are chemical equations important? • How do you balance a chemical equation? • What are the five general types of equations? • How can you predict if a metal will replace another in a compound? • What do the terms oxidation and reduction mean? • How are redox reactions identified? • How can the source of energy changes in a chemical reaction be identified? • How do exergonic and endergonic reactions compare? • How do exothermic and endothermic reactions compare? • Is energy conserved during a chemical reaction? • What is the Law of Conservation of Mass? • What is a chemical reaction? • How is an element's identity determined?	**Science and Engineering Practice** **2. Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world but have implications on the behavior of the modeled systems and can identify limitations of their models. **7. Engaging in argument from evidence** Students critically evaluate evidence supporting an argument and create written or oral arguments that invoke empirical evidence, scientific reasoning and scientific explanations. **2.Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.

of the atoms underlying the reaction. Students should be able to predict the products of the reactions, which also require the ability to recognize the general patterns for each type of reaction. These standards build on the idea that balancing chemical reactions provide 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. Students who demonstrate understanding can use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.

Misconceptions

Law of Conservation of Mass does not apply to atoms." Students may be able to repeat the Law of Conservation of Mass, but see no problem with atoms disappearing or appearing to balance equations.

"Elements can form other elements." Several students when questioned about the appearance of copper on magnesium ribbon in copper sulfate remarked that the brown solid came from the magnesium. They thought it was somehow present in the magnesium even though they agreed that magnesium was an element.

- How does an atom's electron configuration affect its chemical properties**?**
- How are atoms of one element different from atoms of another element?

Learning Outcomes

- Construct the chemical formula of a compound using the periodic table.
- Balance simple chemical equations, identifying the reactants, products, and proper coefficients.
- Predict the products of common chemical reactions.
- Describe synthesis, decomposition, single-replacement, and double replacement reactions using equations.
- Use information about an element's position in the periodic table to determine the charge of its ions.
- List the three major subatomic particles and distinguish among their location, charges, and relative masses.
- Know the chemical symbols for the common elements.
- Use the periodic table to identify the characteristics and properties of metals, non-metals, and metalloid.
- Label a periodic table with oxidation numbers of main group elements.
- Identify elements likely to form ions and use information to construct formulas for compounds.
- Explain ionic and covalent bonding based on the oxidation numbers of the elements in a compound.

Phenomenon

When I squeeze the outside rind of an orange over a balloon - the balloon pops! What is going on?!? Then I find out this same stuff that comes out of the rind is flammable!?!? Are oranges flammable? What is this stuff and how does it pop balloons?

Several questions you may ask about this phenomenon:
1. Does this count as a chemical reaction?
2. How do we know?
3. What are the chemicals?
4. Why are they reacting?
5. Where is the energy coming from?

Caption Question
(Figure 14 p.595)

5. Energy and Matter
Students demonstrate and explain conservation of mass and energy in systems, including systems with inputs and outputs.

	The chemical reactions happening inside the abdomen of a firefly produce light. *Infer.. How do you know these are exergonic reaction?* **Launch Lab on Rusting** https://catalog.mcgraw-hill.com/repository/private_data/DOC/50000027/50/87.pdf **Conservation of mass Lab (lab materials needed)** https://catalog.mcgraw-hill.com/repository/private_data/DOC/50000571/85/21.pdf	

Vocabulary
exothermic reaction, endothermic reaction, equilibrium, reactants, products, chemical equation, coefficient, mole, molar mass, synthesis reaction, decomposition reaction, single replacement reaction, double replacement reaction, combustion reaction, oxidation-reduction

Curricular Materials
Glencoe Physical Science Teacher Edition **Chapter 19 Chemical Reactions** **<u>19.1 Chemical Changes</u>** Practice Problems 1- 4-16; p. 587. Section Review p. 589. **<u>19.2 Classifying Chemical Reactions</u>** Caption Question pp. 591,593. Types of chemical reactions video https://www.youtube.com/watch?v=M96tUDiZ5DQ **<u>19.3 Chemical Reactions and Energy</u>** Section Review p. 597. Visual Learning p. 596. Caption Question pp. 595 & 596.

Khan Academy Video on Chemical Reactions
https://www.khanacademy.org/science/biology/chemistry--of-life/chemical-bonds-and-reactions/v/chemical-reactions-introduction

19.4 Reaction Rates and Equilibrium

Practice Problems 14-16; p. 567.

Caption Question p. 602.

Section Review p. 604

Find out about convection, conduction, and radiation. Click on the "Heat Review Game" link for a fun online quiz. http://www.mansfieldct.org/schools/mms/staff/hand/convcondrad.htm

Great inexpensive experiments and student activities:
http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/thermal/detect.html

Learn about heat transfer by advancing from page to page using the "Next" button. View illustrations with a boiling ball and discuss three types of heat transfer involved. Includes questions with answers.
http://apollo.lsc.vsc.edu/classes/met130/notes/chapter2/htrans_intro.html

“Adjusting your Water Heater to conserve Energy”. Students are introduced to the Law of Conservation of Energy, specific heat, thermal energy and heat capacity as they discover ways to conserve energy. http://serc.carleton.edu/sp/mnstep/activities/27295.html

Video on how heat and energy move through your home:
https://www.teachingchannel.org/videos/stem-lesson-ideas-heat-loss-project

Types of chemical reactions Web resources

https://www.thoughtco.com/types-of-chemical-reactions-604038

http://www.dummies.com/education/science/chemistry/the-common-types-of-chemical-reactions/

https://chemfiesta.org/2015/09/08/the-six-types-of-reaction/

https://www.asd5.org/cms/lib4/WA01001311/Centricity/Domain/638/Five%20Types%20of%20Chemica%20Reactions.pdf

Exothermic and Endothermic reactions

Students will watch the video (Khan Academy) on exothermic and endothermic reactions
https://www.khanacademy.org/science/biology/energy-and-enzymes/free-energy-tutorial/v/endergonic-exergonic-exothermic-and-endothermic-reactions

Performance Task
Ions Names- Give students a list of compound names that consist of the various ions presented in this chapter. Have them write the correct formulas for these compounds (p.567).

Performance Task
Have students inspect the ingredients list on the sides of various containers and find five chemical formulas. Have them determine the oxidation numbers of the various elements in each of the five compounds and make a table to exhibit their findings (p.567).

The Overarching Question(s)		
What are acids and bases? What is pH and how does it measure the concentration of acids and bases? How do acids and bases react with each other?		
DCI, Standards, Explanations, Misconceptions **Length [5 days]**	**Learning Outcomes/Phenomena (Anchor, Driving)**	**3-Dimensional Instructional Approach** **(SEP's & CCC's)**
DCI PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS1.12 Classify a substance as acidic, basic, or neutral by using pH tools and appropriate indicators. PSCI.PS1.13 Research and communicate explanations on how acid rain is created and its impact on the ecosystem. **Explanation** The concept of pH is first introduced in seventh grade as a chemical property of matter. Students in high school should be introduced to multiple explanations of acid and base behavior to permit classification of common substances (e.g. baking soda, ammonia, carbon dioxide) as acids or bases. Since first grade, discussions about ecosystem have	**Essential Questions** • What are acids and bases? • What is pH and how does it measure the concentration of acids and bases? • How do acids and bases react with each other? • What defines an acid or a base? • How are common acids and bases used? • How do acids and bases form ions in solutions? • What determines the strength of an acid or a base? • How effectively do different acids and bases conduct electricity? • What is the difference between strength and concentration? • What is a neutralization reaction? • What is a salt, and how does it form? • What is the purpose of the indicator in a titration? • How do soaps and detergents doffer? • What is acid rain?	**Science and Engineering Practice** **1. Asking questions** Questions originate based on experience as well as need to clarify and test other explanations or determine explicit relationships between variables. **2. Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world but have implications on the behavior of the modeled systems and can identify limitations of their models. **Crosscutting Concept** **1. Patterns** *Different patterns may be observed at each of the*

involved relatively stable ecosystems, limiting disturbances to the impact of introduced species on these stable ecosystems. Under stable conditions, ecosystems remain in a condition of dynamic equilibrium. Catastrophic events can destroy entire ecosystems. Acid rain is one event that can destroy ecosystems. Acid rain describes any form of precipitation with high levels of nitric and sulfuric acids. It can also occur in the form of snow, fog, and tiny bits of dry material that settle to Earth. Students can research factors that contribute to acid rain. Including the biggest culprit is the burning of fossil fuels by coal-burning power plants, factories, and automobiles. **Misconceptions** **OH- Bases** Most of the bases examined in this section have OH- bonded to a metal. Students might have seen the OH symbols connected to other compounds called alcohols. This does not mean that alcohols fit the definition of a base. The -OH in an alcohol is called a hydroxyl group and is not the same thing as the hydroxide ion, OH-. Acids can burn and eat material away: Students think of acids as active agents that damage skin and other materials. The idea develops in young children, who learn to think of acids as "dangerous". Acids are not perceived as being particulate, but rather continuous matter with special properties. Neutralization means an acid breaking down Rather than considering neutralization as a reaction between an acid and an alkali, students perceive this as removing acid properties. The alkali may stop the action of an acid, or alternatively the acid may break down. A base/alkali inhibits the burning properties of an acid. Students tend to meet acids in formal education well before alkalis, so ideas about these chemicals are relatively under-developed. Although dilute alkalis are in fact more corrosive than dilute acids, students' perceptions are that they have no corrosive properties, instead acting to or inhibit acids "eating away" other material.	• How is acid rain produced? • What causes acid rain? **Learning Outcomes** • Apply indicators and instruments to classify a material as acidic, basic, or neutral. • Identify a substance as acidic, basic, or neutral based on its pH or response to an indicator or instrument. • Measure and compare the acid neutralizing strengths of antacids. • Recognize the effect of acid rain on the environment. • Conduct research on issues associated with acid rain. • Explain how acid rain is produced. **Phenomenon** The formula for caffeine, the stimulant found in coffee, tea, and many soft drinks, is C8H10N4O2. Caffeine is a weak acid. Caffeinated beverages might stimulate the secretion of stomach acid, which might worsen ulcer symptoms. Acid and bases https://www.khanacademy.org/science/chemistry/acids-and-bases-topic Strengths of acids and bases https://www.youtube.com/watch?v=DupXDD87oHc Glencoe acid and bases http://glencoe.mheducation.com/sites/0078802482/student_view0/unit6/chapter24/ Acid rain is a phenomenon which can adversely affect aquatic life in high mountain lakes that lack buffering from dissolved salts. Acid Rain Videos https://www.youtube.com/watch?v=rqvGeLu8WF8 http://www.aptv.org/IQLEARNING/khan/video.php?readableid=chem31-buffers https://www.youtube.com/watch?v=VILCk2CpUCw	*scales at which a system is studied and can provide evidence for causality in explanations of phenomena.* **2. Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales.

Vocabulary

Acids, hydronium ions, indicator, hydroxide ion, base, strong acid, weak acid, strong base, weak base, solute, solvent, polar dissociation, dispersion, ionization, solubility, saturated solution, unsaturated solution, supersaturated solution, concentration molarity, acid, indicator, base, neutralization, salt, pH, buffer, electrolyte, nonelectrolyte, nonpolar, acid rain, fossil fuels, fog, sulfuric acid

Curricular Materials

Glencoe Physical Science Teacher Edition
Chapter 22 - Acids, Bases and Salts

22.1 Acids and Bases

Caption Question p. 680.

Review Problems 1- 5; p. 683.

Section Summary p. 683.

Acids and Bases Brain Pop
https://www.brainpop.com/science/matterandchemistry/acidsandbases/

https://educators.brainpop.com/video/33282/

22.2 Strengths of Acids and Bases

Caption Question p. 686.

Section Review p. 687.

pH scale Brain Pop
https://www.brainpop.com/science/matterandchemistry/phscale/

Khan Academy Video on pH
https://www.khanacademy.org/science/high-school-biology/hs-biology-foundations/hs-ph-acids-and-bases/v/introduction-to-ph

22.3 Salts

Caption Question pp. 689, 692,694.

Khan Academy Video on Salts
https://www.khanacademy.org/science/chemistry/acids-and-bases-topic/copy-of-acid-base-equilibria/v/acid-base-properties-of-salts

Acid Rain – In the Field p.698 TE

Performance Task
Students will complete a WebQuest (p.698) and investigate "How is acid precipitation affecting your community?" students will work with a partner to locate information and evidence of the effects of acid

precipitation. Explain how scientific knowledge informed decisions made by your local government. What actions resulted from this knowledge, such as legislation, studies, or activities?

Performance Task

Students will research the effects of acid precipitation on the health of humans. Have them present their findings to the class. If available, have students use presentation software to create a presentation for the class.

Where in the U.S is acid rain most severe Virtual Lab Test
http://www.glencoe.com/sites/common_assets/science/virtual_labs/CT11/CT11.html

Acid Rain Web Resources

http://www.scienceclarified.com/A-Al/Acid-Rain.html

http://www.weatherforkids.org/volcanoes.html

https://www.britannica.com/science/acid-rain

To distinguish and describe the three types of matter: elements, compounds, mixtures, students engage in two activities described on this website: http://mypages.iit.edu/~smile/ch9021.html

Create PREZI on Classification on Elements Compounds and Mixtures
https://prezi.com/jafqrbq8ayqj/elements-compounds-and-mixtures/

Instructions for a lab activity in which students determine whether certain changes in matter are chemical or physical, and to describe the changes in detail using observational skills in the form of a printable handout: http://www.highschool247.com/sc8/secure/chemistry/chemphyslab.html