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 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.

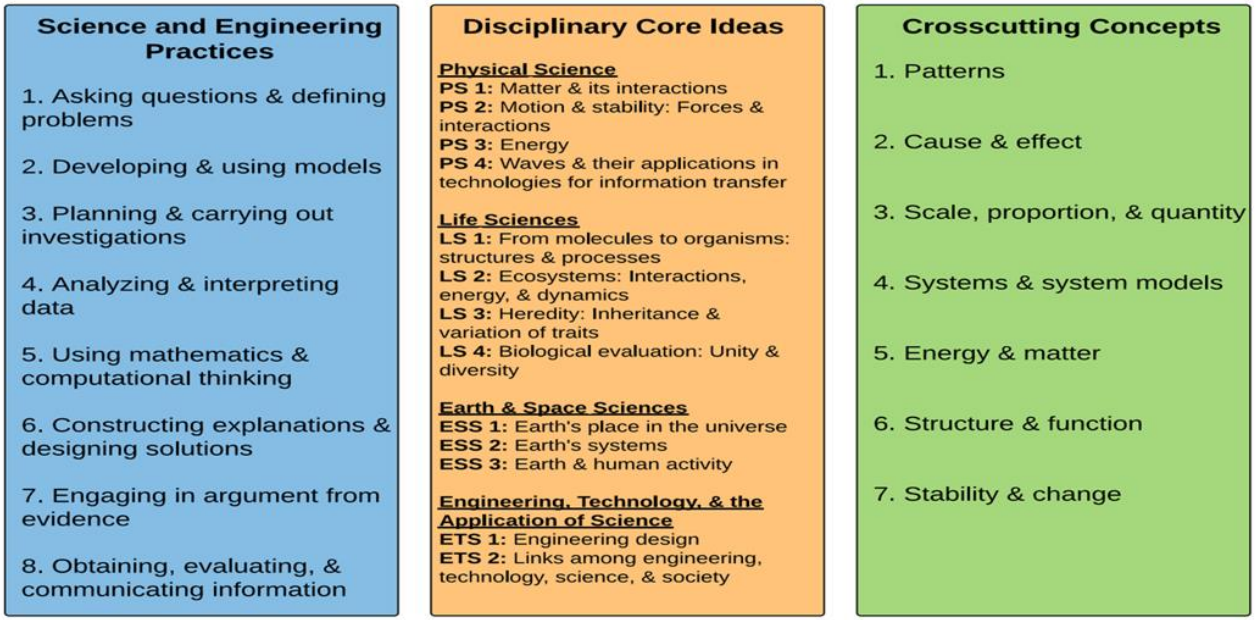
The Tennessee Academic Standards for Science were developed using the National Research Council's 2012 publication, A Framework for K-12 Science Education as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science 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.



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.

Biology Quarter 1 Curriculum Map Curriculum Map Feedback Survey					
Quarter 1		Quarter 2	Quarter 3	Quarter 4	
Structure and Routines	**Unit 1 Cellular Structures & Energy Processes**	Unit 2 Cell Division & Reproduction	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
WEEK 1	**8 Weeks**	9 Weeks	9 Weeks	4 Weeks	5 Weeks

WEEK 1 [5 days]: STRUCTURES AND ROUTINES

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

Unit 1: Cellular Structures & Energy Processes [8 Weeks]

Overarching Question(s)

How do organisms live, grow, respond to their environment, and reproduce?

Unit, Lesson	Lesson Length	Essential Question(s)	Vocabulary
Unit 1 **Characteristics of Living Things**	**1 Week**	• What characteristics do all living things share?	Cells, DNA, metabolism, homeostasis, evolution, biology, sexual reproduction, asexual reproduction, stimulus, evolve

Three Dimensional Components: Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** **BIO1.LS1.1** Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non-living based on these characteristics. ***Students will revisit viral reproductive cycles in greater depth in the later parts of the Heredity unit.*** **Explanation(s) from Updated TN Science Reference Guide**	**Learning Outcomes (*Possible Objectives*)** • Identify the characteristics that all living things share. • Construct an argument from evidence explaining why viruses are not living. **Suggested Phenomenon(s)** **Viral Particles: Alive or Not?** **Performance Task:** Using the characteristics of life, construct an argument from evidence explaining why viruses are not living.	**Curricular Resources** **Textbook Materials** *Miller & Levine TN Biology* • Chapter 1 Lesson 1.3: Patterns in Life, pgs. 22-29 • Chapter 8 Lesson 8.1: Life is Cellular, pgs. 242-247 • Chapter 8 Lesson 8.4: Homeostasis and Cells, pgs. 266-269 **Engage** Interactive Video: Characteristics of Life Cell Theory: Class Discussion Maintaining Homeostasis: Class Discussion Interactive Video ~ Characteristics of Life **Explore** Interactivity: Studying Life Quick Lab: What is a Cell? TE/SE pg. 243

This standard serves to expose students to a variety of living organisms, including unicellular organisms, with a focus the patterns emergent across all living groups. Students first encounter cells, in seventh grade, to observe that all living things: are composed of cells, respond to stimuli, maintain their internal environments through homeostasis, and transfer genetic information to their offspring. Standard 7.LS1.1 specifically addresses cellular organization from cell to organ system in multicellular organisms. While unicellular life may be introduced in the context of 7.LS1.3, the emphasis of seventh grade is on multicellular organisms.

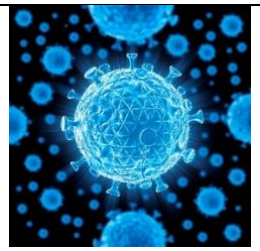
Microscopic analysis of a variety of cells can be employed to compare shapes, sizes, and visible structures in order to help students recognize patterns in the similarities and differences, as well as aiding in model development, limitations, and interpretations.

Biology 1 discussions introduce viral particles and viral cycles, building on student understanding of living organisms to engage in an argument regarding the classification of a viral particle as either living or non-living. While there is consensus around the classification of a virus as non-living, teachers might initially use broader definitions for life in order to foster deeper thought around metabolic and reproductive strategies across domains.

(Discussions of viral life cycles should be limited demonstrating the need a host to replicate viral genetic information and proteins. Use of specific viral reproductive strategies is appropriate for enrichment and instruction, but beyond the scope of this standard.)

Misconceptions

- Homeostasis is essential for organisms to survive because cells require relatively constant conditions to



Are synthetic cells life?
Performance Task: Watch the following clip from ABC news. Using the information, you know about the characteristics of life, determine if the cells that were created in the laboratory are "alive." Construct an argument defending whether these cells are alive or not alive https://www.youtube.com/watch?v=aRzrYNVXF2

Suggested Performance Task
Argument from Evidence
Students will be given data to analyze about a new possible life form found by the Mar's Exploration Program. Using the data, they will have to construct and argument stating their opinion for or against the new material being called a life form.
Mars Life

Interactivity: Prokaryotes and Eukaryotes
Interactivity: Multicellular Life
Are Viruses Alive? Viral Life
Studying Life Studying Life Lab
Characteristics of Life Walk-around Laboratory Walk-Around Lab

Explain
Biology and Technology Solve Problems: Case Study Wrap Up TE/SE pg. 30-31
What exactly is life? What is Life?
Researchers may have solved the origin of life conundrum Origin of Life

Elaborate
Develop a Solution Lab: Algae in the Water TE/SE pg. 28-29
Bioremediation: Using Cells to Clean up Pollution TE/SE pgs. 274-275
Case Study "Life, the final Frontier" Life Case Study

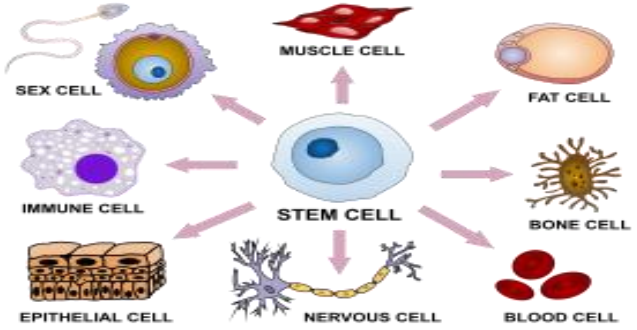
Evaluate
Case Study: Investigating Hydroponics TE/SE pg. 6-7, 34-35
STEM PBL Project: Raising Algae for Biofuels
Lesson 1.3 Review, Questions 1 & 5, pg. TE/SE 29
Study Guide-Concept Map; TE/SE pg. 33
Ch. 1 Assessment, Section 1.3, questions 19-23; TE/Se pg. 37

Additional Resources
New Visions for Public Schools 5E Plan – Characteristics of Life
New Visions for Public Schools 5E Plan – Cell Theory

function properly. If these conditions are not met, many processes, such as protein synthesis and the transport of substances across cell membranes, will not occur. • ***Viruses are not alive.*** Viral particles have some of the characteristics of life, but not all of them. In particular, viruses do not respond to stimuli, viruses do not reproduce without the use of host cell machinery and materials, viruses **Suggested Science and Engineering Practice** **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.* **Suggested Cross Cutting Concepts** **Patterns** *Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations.*		

Biology Quarter 1 Curriculum Map **Curriculum Map Feedback Survey**				
Quarter 1	Quarter 2	Quarter 3	Quarter 4	
Unit 1 **Cellular Structures** **&** **Energy Processes**	Unit 2 Cell Division & Reproduction	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	9 Weeks	9 Weeks	4 Weeks	5 Weeks
Unit 1- Cellular Structures & Energy Processes				
Overarching Question(s)				
How do organisms live, grow, respond to their environment, and reproduce?				

Unit, Lesson	Lesson Length	Essential Question(s)	Vocabulary
Unit 1 Cellular Structures & Energy Processes	**7 days**	• How is the structure of water important to its role within the cell? • How are a protein's structure and function related?	Hydrogen bond, cohesion, adhesion, monomer, polymer, carbohydrate, lipid, nucleotide, nucleic acid, protein, amino acid, cytoplasm, organelle, ribosome, endoplasmic reticulum, Golgi apparatus, vacuole, lysosome, cytoskeleton, chloroplast, mitochondrion, cell wall, lipid bilayer, selectively permeable

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.2 Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. **Explanation(s) from Updated TN Science Reference Guide** The cells of a multicellular organism originate from a single cell. Repeated rounds of cellular division and varied expression of genes result in differentiation into a variety of cells types. The intent of this standard is not for students to construct models of a single cell, but rather to compare models for cells with differing roles in an organism. Students should focus on the relationship between the function of the cell in the organism, the prevalence of various organelles within that cell, and the composition of the different organelles. The relationships between these components can connect to specific cellular examples such as: the absence (or enucleation) of the nucleus in red blood cells in mammals providing for increased levels of oxygen transport in organisms, abundant cytoskeletal protein for	**Learning Outcomes** • Identify the major classes of biological molecules and their functions. • Analyze differences between different cell types, and their organelles. • Construct an argument from evidence about what organelles might be present in specific cell types. **Suggested Phenomenon** Differentiation and the Fate of Cells The differentiation of cells in the human body. The cells of the human body all begin the same, but they modify their cellular components based on their functions. Thinking about the needs of the different cells, make predictions of the cellular organelles that the cells will need to perform those functions.  	**Curricular Resources** **Textbook Materials** *Miller & Levine TN Biology* • Chapter 2 Lesson 2.1 The Nature of Matter (Reference) • Chapter 2 Lesson 2.2 Properties of Water, pgs. 47-51 • Chapter 2 Lesson 2.3 Carbon Compounds pgs. 52-57 • Chapter 8 Lesson 8.2 Cell Structure pgs. **Engage** Video: Chemistry of Durian Fruits Interactivity: Unique Water Properties Interactivity: Understanding Macromolecules Interactivity: Cell Structure Specialized cells Interactive Cystic Fibrosis Video CF Video The Operating System of Life OS of Life Interactivity: Prokaryotes & Eukaryotes **Explore** **Laboratory Activities/Investigations** Case Study: Something is missing. But what? pg. 41 Analyzing Data: Trace Elements pg. 54 Case Study: What's Happening to me? pg. 241 Quick Lab: What Is a Cell? pg. 243 Open-Ended Inquiry: How can you make a model of a cell? pg. 255

movement in animal muscle cells, or the lack of centrioles in most neurons. Models at the scale of cells-organelles can reveal patterns in the roles of cells based on the prevalence of particular organelles. At smaller scales, discussions at the organelle-macromolecule scale facilitate observations of patterns in the molecular composition of organelles based on their function within the cells. Student models should be practical and allow students to hypothesize about the structure/composition of cells performing a given function or function of a cell. Bundled with bio1.ls1.1, students can use their models as evidence to discuss the endosymbiont origin of eukaryotes. **Misconceptions** • ***Prokaryotic cells have no DNA.*** These cells have DNA, but not have a nucleus. • ***Plant cells have chloroplasts, but not mitochondria***. Plant cells have both chloroplasts and mitochondria, as they must perform both photosynthesis and cellular respiration. • ***The organelles are free floating in the cytoplasm***. Organelles are numerous and are held in place by the cytoskeleton. **Suggested Science and Engineering Practice** **Developing and using models** *Students can create models for interactions of two separate systems.* **Suggested Cross Cutting Concepts** **Structure and Function**	**Suggested Performance Tasks** **Special Cells** Students will research a specific cell type found in an animal, and a specific cell type found in a plant, and will create a poster to explain the similarities and differences between the two cell types.	Analyzing Data: Mitochondria in a Mouse pg. 268 What Leeuwenhoek Saw Leeuwenhoek Cell Explorer Activity Cell Explorer **Explain** Macromolecules Part 1 Organic Molecules Bone Cell Signaling Bone Cell Signaling **Elaborate** Science Skills Activity: Dietary Fat and Blood Cholesterol Levels (Handout) Science Skills Activity: Specialized Cells (Handout) PBL: What Structures Make Up Algal Cells?; TE/SE pgs. **Evaluate** Harnessing the Fear of Water TE/SE pgs. 66-67 Lesson 2.2 Review; TE/SE pg. 51 Assess on The Spot; TE. Pg. 56 Lesson 2.3 Review; TE/SE pg. 57 Demonstrate; TE pg. 57 Lesson 2.3 Quiz Chapter 2 Assessment Section 2.2 & 2.3; TE/SE pg. 68 Lesson 8.1 Review; TE/SE pg. 247 Lesson 8.2 Section Review; TE/SE pg. 257 Ch. 8.2 Lesson Quiz Ch. 8 Assessment, Sections 8.1 & 8.2; TE/SE pg. 276 **Additional Resources** HHMI Enrichment Video: Got Lactase? The Co-evolution of Genes and Culture – Part 1 HHMI Enrichment Video: Got Lactase? The Co-evolution of Genes and Culture – Part 2 HHMI Enrichment Activity: Got Lactase? Blood Glucose Data Analysis

Students create and manipulate a variety of different models: infer the function of a component of a system based on its shape and interactions with other components		

Biology Quarter 1 Curriculum Map **Curriculum Map Feedback Survey**				
Quarter 1	Quarter 2	Quarter 3	Quarter 4	
Unit 1 **Cellular Structures** **&** **Energy Processes**	Unit 2 Cell Division & Reproduction	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	9 Weeks	9 Weeks	4 Weeks	5 Weeks

Unit 1: Cellular Structures & Energy Processes [8 Weeks]			
Overarching Question(s)			
How do organisms live, grow, respond to their environment, and reproduce?			
Unit, Lesson	**Lesson Length**	**Essential Question(s)**	**Vocabulary**
Unit 1 **Cellular Structures** **&** **Energy Processes**	**5 days**	• How is the structure of water important to its role within the cell? • How are a protein's structure and function related? • What is the role of enzymes on biochemical reactions within the cell?	Chemical reaction, reactant, product, activation energy, catalyst, enzyme, substrate
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.5 Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein.		**Learning Outcomes** • Explain the importance of protein structure and function • Conduct investigations into environmental variables which can affect protein function • Predict changes in enzyme function due to environmental variables **Suggested Phenomenon(s)** Snake Venom – When a venomous snake bites a prey animal, it releases an enzyme which can be categorized as a neurotoxin, cytotoxin or	**Curricular Resources** **Textbook Materials** *Miller & Levine TN Biology* • Chapter 2 Lesson 2.3 Carbon Compounds; TE/SE pgs. 55-57 • Chapter 2 Lesson 2.4 Chemical Reactions and Enzymes; TE/SE pgs. 60-61 **Engage** Class Discussion: Matter and Energy Optimal Enzyme Activity Paperase

Explanation(s) from Updated TN Science Reference Guide

Standards in earlier grades do not mention proteins, so students will primarily view proteins in the context of food and nutrition. It is strongly encouraged to provide students with examples of some specific functions of proteins within the body before relating protein structure to protein function. Bundling this standard with Bio1.LS1.4 and providing the context of a specific protein (e.g. opsin pigments produced by the OPN1LW gene) can provide a very logical framework for students to understand protein function. Using examples of specific proteins and pathways provides concrete evidence for the variety of protein functions and allows students to connect protein function to phenotypes. Additional roles of proteins include cellular regulation, cell signaling, enzymatic function, and structural components.

The intent of this standard is to establish that a protein's function is an outcome of its structure. By extension, this means that changes to the structure of a protein, either through mutation (Bio1.LS3.2) or through interactions with the environment, will affect the protein's ability to function.

Discussions of specific levels of organization (e.g. primary vs secondary structure) may be useful for enrichment, but they are beyond the scope of the standard. An appropriate level of understanding can be accomplished by introducing students to patterns relating proteins of known function to presence of common domains in the structures of these proteins. Simulations (e.g. http://lab.concord.org/embeddable.html#interactives/samples/5-amino-acids.json) provide platforms for investigations where students gather evidence that charge and polarity influence protein shapes.

The investigations referenced in this standard should provide evidence for how interactions with the environment may affect a proteins ability to function. Investigations might include the effect of amylase activity on a starch substrate as a function of varying

haemotoxin. Haemotoxic venom destroys red blood cells, disrupts clotting, or damages organs.

Is a fever good for you? When we are infected with a viral or bacterial pathogen, the body responds by increasing the core body temperature. Most of us would respond by attempting to decrease that temperature, through the use of analgesics. However, a mild increase in body temperature increases the activity of the enzymes in the body's defense cells, white blood cells, while, at the same time, decreasing the activity of viral and bacterial enzymes.

Cancer protein structure Cancer Protein

Suggested Performance Tasks

Disease due to lack of protein. Students will research diseases caused by a lack of proteins and create a presentation which shares the features of the disease, including causes, locality, signs and symptoms, and treatments.

Crickets in My Lunch?

After reading about the use of crickets for human consumption as a food source, students write a response to the following question: How can the addition of crickets make school lunches more nutritious? Students will apply what they have learned about digestion, macronutrients, and human energy needs in order to write an informational paragraph or essay about why crickets are a good food source and can make school lunches more nutritious.

Enzyme Controlled Reactions

Explore

Laboratory Activities/Investigations

Enzyme Activity Pasco Lab Vernier Lab
Enzymatic Browning Activity Browning Lab
Enzymatic Digestion Laboratory Digestion Lab
Exploration Lab: Temperature and Enzymes TE/SE pg. 60
Interactivity: Functioning of Enzymes
Enzyme Activity Lab

Explain

Constructing Explanations – Explain how consuming an acid-neutralizing antacid might affect protein digestion. Have students apply the concept of activation energy to support their explanations.

Elaborate

Articles

Fly on the most wanted list Fly Article
How could dragons breathe fire? Dragon Article
Climate change and food Climate and Food
Constructing Explanations – Tell students that during the recycling process, ink is removed from paper using enzymes. Assign students to groups and have the groups research this process and find out which enzymes are used. Students should use the diagram in Figure 2-24 to explain how enzymes work to remove the ink from the paper. Additionally, groups should discuss why the use of enzymes instead of harsh chemicals o this process is more cost-efficient and economic. Groups should prepare a presentation including all information.

Evaluate

Lesson 2.4 Review; TE/SE pg. 61
Lesson Quiz: Chemical Reactions and Enzymes

temperature or another independent variable, such as pH. Control groups should be included in the investigation in order to establish a baseline for enzyme function. **Misconceptions** • ***Solutions only consist of solids and liquids.*** Solutions can involve different states of matter • ***Energy is released to break bonds.*** Energy is required to break bonds, and energy is released when new bonds form. It is the net energy change in energy that determines whether the chemical change overall releases or absorbs energy. • ***Enzymes give energy to the substrates to decrease the activation energy.*** Enzymes are not used in a chemical reaction. They do not provide energy for a reaction, they put the substrates into the right conformation to allow the chemical reaction to proceed • Spontaneous Chemical Reactions. Students may equate "spontaneous" with "fast." Explain that spontaneous reactions do not necessarily occur quickly. A spontaneous reaction occurs without an added source of energy but could take a long time. Diamonds spontaneously decay into graphite, but it takes millions of years! **Suggested Science and Engineering Practice** **Constructing Explanations and Designing Solutions** *Construct an explanation using models or representations. Apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena, examples, or events* **Suggested Cross Cutting Concepts** **Structure and Function** *Students create and manipulate a variety of different models: infer the function of a component of a system based on its shape and interactions with other components*		Chapter 2 Assessment, Section 2.4; TE/SE pg. 69 **Additional Resources** New Visions for Public Schools 5E Plan – Macronutrient Assembly and Breakdown (Enzymes) The Concord Consortium Amino Acid Assembly

Biology Quarter 1 Curriculum Map Curriculum Map Feedback Survey				
Quarter 1	Quarter 2	Quarter 3	Quarter 4	
Unit 1 **Cellular Structures** **&** **Energy Processes**	Unit 2 Cell Division & Reproduction	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	9 Weeks	9 Weeks	4 Weeks	6 Weeks

Unit 1: Cellular Structures & Energy Processes [8 Weeks]

Overarching Question(s)

How do organisms live, grow, respond to their environment, and reproduce?

Unit, Lesson	Lesson Length	Essential Question(s)	Vocabulary
Unit 1 **Cellular Structures** **&** **Energy Processes**	**7 days**	• How does the cell move materials through the plasma membrane?	Diffusion, facilitated diffusion, aquaporin, osmosis, isotonic, hypertonic, hypotonic, osmotic pressure, tissue, organ, organ system, receptor, specialization

Standards and Related Background Information

DCI

BIO1.LS1: From Molecules to Organisms: Structures and Processes

Standard

BIO1.LS1.7 Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells

Explanation(s) from Updated TN Science Reference Guide

In the seventh grade, students learn about the presence of the plasma membrane and perform initial investigations of passive transport. A portion of the instruction to this Biology 1 standard should utilize the fluid mosaic model to make sense of cellular

Instructional Focus

Learning Outcomes

- Explain the various modes of cellular transport
- Create and test a prediction about the movement of molecules across a membrane.

Suggested Phenomenon

What would happen to a human if they were given an IV full of pure water? As the blood stream increased the concentration of water, osmosis would increase into cells, leading to cellular swelling and possibly damage. There would also be problems with the concentration of ions and proteins within the blood, leading to issues with cellular signaling.

Instructional Resources

Curricular Materials

Textbook Materials

Miller & Levine TN Biology

- Chapter 8.2 Cell Structure; TE/SE pgs. 256-257
- Chapter 8.3 Cell Transport; TE/SE pgs. 260-265

Engage

Interactivity: Osmosis
Teacher Demo: The Fluid Mosaic Model; TE pg. 256
Cell Defense: The Plasma Membrane Game
Connect: Class Discussion- In or Out

Explore

Laboratory Activities/Investigations

Open-Ended Inquiry: Detecting Diffusion; TE/SE pg.261
PHeT Interactive: Membrane Channels
Science Skills: Cell Transport in Plants

Explain

Articles

phenomena, understanding students may not have discussed membrane composition previously. In Biology 1, concepts of cell transport expand to include both passive and active transport processes. The basic principles of homeostasis relate to understanding why active transport is necessary; environmental conditions do not always favor the flow of matter and energy into or out of an organism. Organisms must have pathways to maintain equilibrium conditions of matter and energy, even in the presence of unfavorable environmental conditions (e.g., paramecia in hypotonic environment). It is important to differentiate mechanisms that allow organisms to regulate their internal environments (homeostasis), from the principles of chemical equilibrium established by passive transport processes. By placing cylinders cored from a potato into sucrose solutions with concentrations ranging from 0M to 1M at 0.2M intervals, students can build on their middle school understanding of passive transport by quantifying the impact of the solution on the mass of the potato cores. (Note: Students may have used particle diagrams for matter as early as 3rd grade.) This activity emphasizes that the direction of transport depends on the environment, and that environmental conditions do not always establish internal conditions necessary for basic cell functioning, thus cells must have mechanisms to respond. Investigations into transport across membranes might include making predictions regarding factors affecting the transport of molecules including molecular properties (sizes or polarities), membrane components, intracellular and extracellular environments. Types of transported materials might include gases, water, small ions, monomers, polymers, viruses, or single celled organisms.	 Strange but True, Drinking Too Much Water Can Kill You Too Much of a Good Thing? The danger of water intoxication in endurance sports.	Reverse Osmosis and Space Travel Space Article Lionfish and osmosis Lionfish Article Cellular Boundaries: Argue from Evidence; TE pg. 256 Passive Transport: Connect to Earth Science; TE pg. 261-262 Active Transport: Visual Summary; TE/SE pg. 264 Diffusion Lab: Prediction vs. Results **Elaborate** **Case Study** Mitochondria in a Mouse; TE/SE pg. 268 **Evaluate** Lesson 8.3 Review; TE/SE pg. 265 Lesson Quiz: Cell Transport Assess on the Spot; TE pg. 263 Demonstrate: Evaluate Student Progress; TE pg. 265 Ch. 8 Assessment, Section 8.3; TE/SE pg. 277 **Additional Resources** New Visions for Public Schools 5E Plan – Macronutrient Transport

Misconceptions ***Most materials are transported into and out of cells through active transport***. Most nutrients and materials move through passive transport. **Suggested Science and Engineering Practice** **Developing and using models** *Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system mathematical computational thinking* **Suggested Cross Cutting Concepts** **Systems and System Models** *Students create and manipulate a variety of different models: physical*		

Biology Quarter 1 Curriculum Map Curriculum Map Feedback Survey				
Quarter 1	Quarter 2	Quarter 3	Quarter 4	
Unit 1 **Cellular Structures** **&** **Energy Processes**	Unit 2 Cell Division & Reproduction	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	9 Weeks	9 Weeks	4 Weeks	6 Weeks

Unit 1- Cellular Structures & Energy Processes			
Overarching Question(s)			
How do organisms live, grow, respond to their environment, and reproduce?			
Unit, Lesson	**Lesson Length**	**Essential Question(s)**	**Vocabulary**
Unit 1 **Cellular Structures** **&** **Energy Processes**	**7 days**	• What is the function of ATP in cells? • How is energy transferred from light energy into stored energy in the cell? • What are the reactants and products of photosynthesis? • What factors affect photosynthesis?	ATP, Photosynthesis, Pigment, Chlorophyll, Thylakoid, Stroma, NADP+, light-dependent reactions, light-independent reactions, photosystem, electron transport chain, ATP synthase, Calvin cycle

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.8 Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product **Explanation(s) from Updated TN Science Reference Guide** Students should see that photosynthesis serves two purposes: the process stores radiant energy from the sun in chemical bonds and transfers matter from non-living systems (the atmosphere) into living systems (the biosphere). Students may need to revisit the idea of chemical energy (and other energy types) introduced in 6.PS3.1 and 6.PS3.2. Simple demonstrations such as burning magnesium ribbon and observing changes in weight and energy release may affirm the interconnections between transformations of energy and rearrangement of matter. Emphasis of this standard should be on building familiarity with typical models of photosynthesis for use in explaining phenomena, not on memorization of the models. For example, how is it possible for trees to grow and get heavier, given that they are not consuming matter by eating other organisms? Discussions regarding active transport establish that the external environment is not always conducive to passive transport, so organisms must use energy to sustain themselves. Photosynthesis is a means to compensate for energy expenditures. Students should	**Learning Outcomes** • Students can explain the role of ATP in the cell • Students can identify the energy transfer steps of photosynthesis • Students can identify and explain the role of the reactants and products of photosynthesis **Suggested Phenomenon** How does photosynthesis occur in plants, which are not green? ~ Students have learned that photosynthesis occurs in the chloroplast, which reflects green light. There are plants which are not green, but which are still able to undergo photosynthesis. How do those plants photosynthesize? Photosynthesis Phenomenon ***Photosynthetic Slugs*** ***Video https://www.youtube.com/watch?v=AcX2n1rC4W4*** **Suggested Performance Tasks** Mars Colonization ~ Oxygen is necessary for life on Earth. To colonize Mars, astronauts will be required to determine a method to produce oxygen, involving photosynthesis. Students will research the required materials that astronauts should take with them to produce enough oxygen to survive.	**Curricular Materials** **Textbook Materials** *Miller and Levine TN Biology* Chapter 9 Photosynthesis • Chapter 9.1: Energy and Life; TE/SE pgs. 282-285 • Chapter 9.2: Photosynthesis: An Overview; TE/SE pgs. 287-290 • Chapter 9.3: The Process of Photosynthesis; TE/SE pgs. 291-297 **Engage** Class Discussion: • Saving for a Rainy Day • Trapping Energy • A Look into the Future; TE/SE pg. 291 **Explore** Lesson 9.1 • Quick Lab: How do Organisms capture and use energy; TE/SE pg. 284 • Interactivity: ATP and Energy • ATP & Batteries; TE/SE pg. 283 Lesson 9.2 • Interactivity: A Model of Photosynthesis • Science Skills Activity: The Effect of Light on the Rate of Photosynthesis; Student Handout • Open-Ended Inquiry ~ Plant Pigments and Photosynthesis TE/SE pg. 289; Foundations Worksheet Lesson 9.3 • Analyzing Data: The Rate of Photosynthesis; TE/SE pg. 296 • Interactivity: The Details of Photosynthesis

see that this energy and biomass are inseparable because the chemical bonds formed during carbon fixation are the mechanism by which the energy of the sun is stored and passed through the biosphere. Specifically, consider the role of photosynthesis in capturing carbon, hydrogen, and oxygen needed to produce other cellular macromolecules such as proteins, lipids, and DNA necessary for growth and reproduction. The chemical reactions needed for constant reorganization of these elements to form new compounds provides a way to transfer energy between systems across all levels of organization. *While photosynthesis does utilize intermediate energy carriers during its reactions, generally the energy-storing compounds produced from photosynthesis are not a practical means of powering the cell. Plants still rely on cellular respiration to yield ATP.* **Misconceptions** • ***Students think that there is a single reaction in which CO2 and H2O become sugar and oxygen***. There are multiple steps to the process of photosynthesis and the two processes occur in different parts of the chloroplasts. • ***The second phase of photosynthesis is called the dark reactions because it only occurs when light is not present***. The light-independent reactions can occur at any time, as they do not require sunlight. **Suggested Science and Engineering Practice** **Developing and using models** *Students can create models for interactions of two separate systems.*		• Science Skills Activity: Photosynthesis and Cellular Respiration; Student Handout Exploration Lab: Effect of Light Wavelengths on Photosynthesis Virtual Lab: Light and Growth Case Study: Sweet Beets: Making Sugar out of Thin Air Photosynthesis Interactive Inquiry Lab: Floating Leaf Disk Assay **Explain** Case Study: What would it take to make an artificial leaf? TE/SE pg. 281 Interactive Video: Amazing Autotrophs CER Activity: Photosynthesis Chemistry Model **Elaborate** Gold Rush for Algae "Bionic plants offer super powered photosynthesis." Bionic Plants "Bionic leaf makes fuel from sunlight." Bionic Leaf "How did plants develop photosynthesis?" History of Photosynthesis STEM Data Analysis: Optimum Condition for Photosynthesis **Evaluate** Lesson 9.1 Quiz Asses on the Spot; TE pg. 83 Lesson 9.1 Review; TE/SE pg. 285 Assess on the Spot; TE pg. 288 Lesson 9.2 Quiz Lesson 9.2 Review; TE/SE pg. 291 Lesson 9.3 Quiz Lesson 9.3 Review; TE/SE pg.29 Ch 9 Assessment; TE/SE pgs. 304-307

Suggested Cross Cutting Concepts **Energy and Matter** *Students explain the conservation of energy by discussing the transfer mechanisms between objects or fields as well as into or out of a system*		**Additional Resources** New Visions for Public Schools 3E Plan - Photosynthesis Chapter 9 Foundations Workbook

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9 weeks	9 Weeks	9 Weeks	4 Weeks	6 Weeks

Unit 1- Cellular Structures & Energy Processes			
Overarching Question(s)			
How do organisms live, grow, respond to their environment, and reproduce?			
Unit, Lesson	**Lesson Length**	**Essential Question(s)**	**Vocabulary**
Unit 1 **Cellular Structures** **&** **Energy Processes**	**9 weeks**	• What is the relationship between photosynthesis and cellular respiration? • What are the steps of cellular respiration? • How efficient are the steps of cellular respiration? • How does cellular respiration follow the laws of thermodynamics?	Calorie, Cellular Respiration, Aerobic, Anaerobic, Glycolysis, NAD+, Krebs Cycle, Fermentation

Standards and Related Background Information	**Instructional Focus**	**Instructional Resources**
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.9 Create a model of aerobic respiration demonstrating flow of matter and energy out of a cell. Use the model to explain energy transfer mechanisms. Compare aerobic respiration to alternative processes of glucose metabolism	**Learning Outcomes** • Students can explain how glucose is used to create ATP. • Students can explain the difference in the efficiency of fermentation and cellular respiration. • Students can explain why ectotherms eat less than endotherms. **Suggested Phenomenon(s)** How do muscles get the energy they need for athletic activity? Cellular Respiration Phenomenon	**Curricular Materials** **Textbook Materials** *Miller and Levin TN Biology* Chapter 10 Cellular Respiration • Chapter 10.1: Cellular Respiration: An Overview; TE/SE pgs. 310-313 • Chapter 10.2: The Process of Cellular Respiration; TE/SE pgs. 314-320 • Chapter 10.3: Fermentation; TE/SE pgs. 321-325 **Engage** Class Discussion

Explanation(s) from Updated TN Science Reference Guide Photosynthesis solves the problem of bringing energy into the biosphere. However, two additional issues surface: energy-storing glucose molecules possess impractically large amounts of energy *and* not all organisms can perform photosynthesis to compensate for the energy needed to power active cell processes. Cellular respiration is the processes that reconciles these two issues. Oxidation of glucose molecules through cellular respiration occurs in both producers and consumers. The reactions of cellular respiration redistribute the relatively large amount of energy stored in a single glucose molecule among multiple, smaller adenosine diphosphate (ADP) molecules. The phosphorylation of the ADP to form adenosine tri-phosphate (ATP) stores a more practical amount of energy for use in cellular processes, such as active transport. The emphasis of this standard should not be on memorization of the typical models that show the series of reactions of respiration. Instead, students should be building familiarity with these models in explain phenomena in living organisms. For example, rather than simply comparing models to aerobic and anaerobic respiration, students might be asked to use the models explain why greater amounts of glucose are metabolized by organisms when they switch to anaerobic pathways under similar conditions of energy expenditure. Students can use models of aerobic respiration to explain how the absence of oxygen necessitates an alternate way to process the byproducts of	***Ghost Redwoods Video https://www.youtube.com/watch?v=os5mZQLpe98&t=151s*** **Suggested Performance Tasks** Carb Crazy ~ Students will research low carbohydrate diets. They will then examine the method that the body uses to break down the biomolecules that are ingested on a low carbohydrate diet. Diets	• Feel the Burn • Baking Bread Inquiry Warm-Up Lab: Maximizing Surface Area **Explore** **Laboratory Activities/Investigations** Carbon Transfer Virtual Laboratory Carbon Transfer Mystery of the Flea Dip Flea Dip Chicago Cyanide Murders Cyanide Case Study Inquiry Lab: Exercise and Cellular Respiration Cellular Respirations in Plants Plants and Cellular Respiration Virtual Lab: Energy in a Cell Analyzing Data: You Are What You Eat: Case Study; TE pg. 311 Interactivity: Cellular Respiration Interactivity: The Mechanics of Cellular Respiration Quick Lab: Rise Up Case Study; TE/SE pg. 323 **Explain** Chemical Energy and Food; TE pg. 311 Glycolysis; TE pg. 315 Fermentation; TE pg. 322 Electron Transport and ATP Synthesis; TE pg. 318 PBL Skills Science Activity: Algae and Biofuels; Student Worksheet Science Skills Activity: Exercise and Mitochondria; Student Worksheet Modeling Lab: Making a Model of Cellular Respiration; Foundations Modeling Lab Interactivity: Comparing Cellular Respiration and Fermentation **Elaborate** **Articles** Ghost Redwoods Ghost Redwoods

glycolysis so that organisms can continue to oxidize glucose when oxygen is unavailable. **Misconceptions** Cellular respiration only takes place in animal cells, not plant cells ~ both plant and animal cells need to release the energy in food and store it as ATP. Energy is created during cellular respiration ~ Energy is transferred from glucose into a form useable by the cell, ATP. The purpose of fermentation is to produce a small amount of energy when cells don't have access to oxygen ~ Fermentation is primarily a recycling mechanism for NAD+ so that the cell can continue to make energy. **Suggested Science and Engineering Practice** **Developing and using models** *Students can create models for interactions of two separate systems.* **Suggested Cross Cutting Concepts** **Systems and System Models** *Students design or define systems in order to evaluate a specific phenomenon or problem.*		Interactive Video: Fermentation and Exercise Ch. 10 Case Study: Can San Francisco sourdough be copied?; TE/SE pgs. 309, 326-327 Enrichment: Cellular Respiration and Energy STEM Activity PBA: Making a Better Bread; TE/SE pg. 330-331 **Evaluate** Demonstrate; TE pg. 313, 320, 325 Assess on the Spot; TE pg. 312, 317, 322 Lesson 10.1 Quiz Lesson 10.1 Review; TE/SE pg. 313 Lesson 10.2 Quiz Lesson 10.2 Review; TE/SE pg. 320 Lesson 10.3 Quiz Lesson 10.3 Review; TE/SE pg. 325 Cellular Respiration Online Test **Additional Resources** New Vision for Public Schools 5E Plan – Cellular Respiration and Experimental Design; Cellular Respiration in Yeast and Experimental Design Pearson Realize: Biology Foundations: Cellular Respiration

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Textbook	**DCIs and Standards**	**Videos**	**Additional Resources**
Miller & Levine TN Biology Teacher Edition Pearson Realize	**DCI** BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.1 BIO1.LS1.2 BIO1.LS1.5 BIO1.LS1.7 BIO1.LS1.8 BIO1.LS1.9	Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The Teaching Channel Teachertube.com	**ACT & SAT** TN ACT Information & Resources ACT Connections SAT Connections SAT Practice from Khan Academy