Shelby County Schools Science Vision

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

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

Introduction

In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we must collectively work to provide our students with high quality standards aligned instruction. The Tennessee Academic Standards for Science provide a common set of expectations for what students will know and be able to do at the end of each grade, can be located in the Tennessee Science Standards Reference. Tennessee Academic Standards for Science are rooted in the knowledge and skills that students need to succeed in post-secondary study or careers. While the academic standards establish desired learning outcomes, the curricula provide 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.

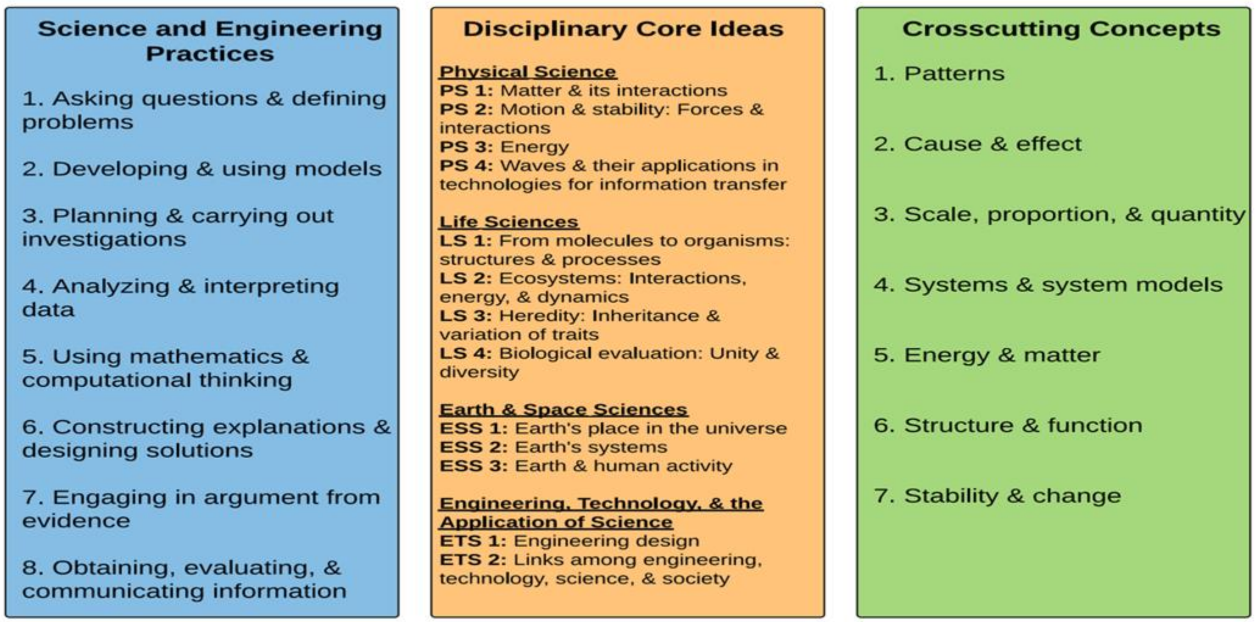
Our collective goal is to ensure our students graduate ready for college and career. Being College and Career Ready entails, many aspects of teaching and learning. We want our students to apply their scientific learning in the classroom and beyond. These valuable experiences include students being facilitators 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 define what to teach and what students need to learn at each grade level. The map is designed to reinforce the grade/course-specific standards and content (scope) and provides *suggested* sequencing, pacing, time frames, and aligned resources. Our hope is that by curating and organizing a variety of standards-aligned resources, teachers will be able to spend less time wondering what to teach and searching for quality materials (though they may both select from and/or supplement those included here) and have more time to plan, teach, assess, and reflect with colleagues to continuously improve practice and best meet the needs of their students.

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

2nd Grade Quarter 4 Curriculum Map [Quarter 4 Curriculum Map Feedback]							
Quarter 1			Quarter 2		Quarter 3	**Quarter 4**	
Structure and Routine	Unit 1 Living Things	Unit 2 Habitats	Unit 3 Earth's Surface	Unit 4 Earth's Changes	Unit 5 Forces and Motion	**Unit 6** **Sound and Light**	
1 week	5 weeks	3 weeks	4.5 weeks	4.5	9 weeks	**9 weeks**	

UNIT 6: Sound and Light (9 weeks)

Overarching Question(s)

How are waves used to transfer energy and information?

Unit 3: Lesson 1	Lesson Length	Essential Question	Vocabulary
Sound	4.5 weeks	How is sound made?	energy, matter, sound, vibrate, volume, pitch

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) 2.PS4 Waves and Their Applications in Technologies for Information Transfer 2.ETS1 Engineering Design **Standard(s)** 2.PS4.1: Plan and conduct investigations to demonstrate the cause and effect relationship between vibrating materials (tuning forks, water, bells) and sound. 2.ETS1.2: Develop a simple sketch, drawing, or physical model that communicates solutions to others. **Explanation and Support of Standard** 2.PS4.1 The relationship between sound and vibration is reciprocal: Vibrating materials create sound, and sound	**Learning Outcomes** Students will be able to explain how sound can make matter vibrate and that vibrating matter can make sound. **Suggested Phenomenon** *Click on the phenomenon picture to view the video.* 	**Curricular Resources** Engage Inspire Science TE, p. 233-234 TE, p. 233, Phenomenon TE, p. 234, Essential Question TE, p. 234, Science and Engineering Practices Explore Inspire Science TE, pp. 235-236 *(LAB)* Be a Scientist Notebook, p. 230, Inquiry Activity: Rubber Band Guitar Science Paired Read Aloud: The Low-Energy Band Explain Inspire Science TE, pp. 237-242

causes materials to vibrate. Water is mentioned in this standard as a way to make the vibrations of the tuning forks and bells visible to students. The sound of the tuning fork may be audible, but it is challenging to see that the fork is actually vibrating. Placing the tips of the tines of a vibrating tuning fork into water will make the vibrations visible as the water is splashed about. Examples of vibrating materials that make sound may include a tuning fork or plucking a stretched rubber band or guitar string. To observed sound making an object vibrate, hold a piece of paper next to a speaker playing loud music. 2.ETS1.2 Sketches, drawings, or physical models should be used by students to share their ideas with classmates. This standard can be paired with other standards in the grade that explicitly mention design tasks (I.E., 2.ESS2.1 or 2.PS4.2) or with standards that utilize teacher-developed design tasks. **Suggested Science and Engineering Practice(s)** Planning and Carrying Out Controlled Investigations Developing and Using Models **Suggested Crosscutting Concept(s)** Cause and Effect **Teacher Overview**	Phenomenon Explanation: Sound can make materials vibrate and vibrating materials can make sound. For example, if you put a bowl of water on top of a music speaker and play a song with a heavy bass at high volume, you can see the surface of the water vibrate. Pluck a guitar string or tap and touch a tuning fork, and you can see or feel the vibrations as the sound is produced. Sometimes students fail to recognize that sound both results from and causes vibrations.	Vocabulary, TE, p. 237 Science File: Energy and Matter Science Paired Read Aloud: Sounds All Around Simulation: Instruments *(LAB)* Be a Scientist Notebook, p. 234, Inquiry Activity: Design an Instrument Digital Interactive: Sound Energy <u>Elaborate</u> Inspire Science TE, pp. 243-245 *(LAB)* Be a Scientist Notebook, p. 237, Inquiry Activity: Throat Vibrations Be a Scientist Notebook, p., Writing in Science <u>Evaluate</u> Inspire Science TE, pp. 245-247 *(LAB)* Be A Scientist Notebook, p. 239, Performance Task: Design an Instrument eAssessment **Additional Resources** Lesson: Conducting Sound Lesson: Investigating Sound Lesson: What Makes Sound Video: What is Sound? Video: Sound Waves and Vibration

When we hear sounds, our eardrums are responding to sound waves—moving air that is set in motion when an object vibrates. Any vibrating object can set off sound waves. Musical instruments such as drums vibrate when they are struck; stringed instruments vibrate when a string is plucked or bowed. When we speak, our larynx (voice box) vibrates. The vibrations are transmitted from our eardrums to our brain, where they are interpreted as sounds. Every sound is produced by a vibrating object, whether it is a tiny speaker vibrating in a radio or a booming thundercloud in the sky. **Misconceptions** Students may think that sound exists independently of objects. Students may also think that sound and hearing are identical concepts or that sound is produced and heard at the same time. Students may think that sound is produced in the ears. They may also think that sound is a constant property of an object, like color or shape. The activities in this lesson will help students to understand the difference between sound and hearing. Students will also gain the understanding that sound is produced through vibrations that travel as waves through a medium.		**ESL Supports and Scaffolds** WIDA Standard 4 To support students in speaking refer to this resource: WIDA Doing and Talking Science When applicable- use Home Language do build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Pre-teach: Vibration; explain; matter; sound Making sound visuals and activities Sentence stems: Sound ___ is ___. ___ caused ___ to ___. Vibrations cause_____

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1 week	5 weeks	3 weeks	4.5 weeks	4.5	9 weeks	**9 weeks**

UNIT 6: Sound and Light (9 weeks)

Overarching Question(s)

How are waves used to transfer energy and information?

Unit 3: Lesson 2	Lesson Length	Essential Question	Vocabulary
How Sound and Light Travel	4.5 weeks	How do sound and light travel to communicate?	waves, reflect

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) 2.PS4 Waves and Their Applications in Technologies for Information Transfer 2.ETS1 Engineering Design 2.ETS2 Links Among Engineering, Technology, Science, and Society **Standard(s)** 2.PS4.2: Use tools and materials to design and build a device to understand that light and sound travel in waves and can send signals over distances. 2.PS4.3: Observe and demonstrate that waves move in regular patterns of motion by disturbing the surface of shallow and deep water.	**Learning Outcomes** Students will be able to create a model to show that sound travels in waves. **Suggested Phenomenon** *Click on the phenomenon picture to view the video.*  **Firefly Communication (Light Signals)**	**Curricular Resources** Engage Inspire Science TE, p. 249-250 TE, p. 249, Phenomenon TE, p.250, Essential Question TE, p. 250, Science and Engineering Practices Explore Inspire Science TE, pp. 250-251 *(LAB)* Be a Scientist Notebook, p. Inquiry Activity: Traveling Sound Explain Inspire Science TE, pp. 252-258 Vocabulary, TE, pp. 252 Video: Sound Waves

2.ETS1.1: Define a simple problem that can be solved through development of a new or improved object or tool or by asking question, making observations and gather accurate information about a situation people want to change. 2.ETS2.2: Predict and explain how human life and the natural world would be different without current technologies. **Explanation and Support of Standard** 2.PS4.2 Devices that transmit signals over long distances allow us use our senses to receive incoming signals. Early signals included smoke signals (seeing) or Morse code (hearing). Khan Academy has a playlist discussing the history of information theory which provides many examples of historical solutions for communicating over distances. Students could be challenged to send a communication over a distance and use this challenge to simultaneously cover several 2.ETS standards. 2.PS4.3 Students can create waves by disturbing the surface of a container of water. The container could be a plastic shoebox, pail, or tub of some variety, large enough to allow students to see the waves travel across the surface. Disturbances might be as simple as dropping a single droplet of water or small pebble onto the surface. Floating objects (e.g. bath toys) can be placed in pan of	Phenomenon Explanation: Light is used for communication by sending a visual signal. This signal can travel farther than sound.	Science File: Light and Sound Are Energy Inspire Science TE, pp. 250-251 *(LAB)* Be a Scientist Notebook, p. 247, Inquiry Activity: Paper Cup Phone Science File: Communicating with Light and Sound Digital Interactive: Use Light and Sound to Communicate Video: Lighthouses Elaborate Inspire Science TE, pp. 259-260 *(LAB)* Be a Scientist Notebook, p. 252, Inquiry Activity: Send Messages Evaluate Inspire Science TE, pp. 260-261 *(LAB)* Be A Scientist Notebook, Performance, p. 254, Performance Task: Lighthouse Communication eAssessment **Additional Resources** Lesson: Communicating with Light Video: Sound and Light Travel in Waves Lesson: Sound and Vibration Video: Sound Waves and Vibration Lesson: Good Vibrations Lesson: Moving Matter

water and student can record how the floating object moves as the wave passes under it: The wave moves towards the edge of the container, but the floating object will just bob up and down. The floating object does not move toward the edge of the container. A wave crashing onto the beach is an example of a wave traveling through shallow water. These waves travel through the ocean just like the waves students are creating in the investigations described above. However, the action of crashing onto a beach is a unique phenomenon that occurs when a wave runs into shallow water. Waves in shallow water are an exception to normal wave behavior, and are not the focus of the remainder of this component idea in later grades. (Shallow wave behavior occurs when the depth of the water is less than the wave's amplitude. And the wave will break if the water is less than half as deep as the wave's height.) 2.ETS1.1 In earlier grades, students have been presented with a problem and worked to make observations that were relevant to the process of formulating a solution to that problem. Engineers design solutions to situations that people want to change or improve. Before designing a solution, a complete description of the situation is created in the form of a problem to be solved. Students should now be presented the opportunity to take a situation or object that they can improved and create a define their own problem to be resolved. Asking questions, making observations, and gathering accurate		**ESL Supports and Scaffolds** WIDA Standard 4 To support students in speaking refer to this resource: WIDA Doing and Talking Science When applicable- use Home Language do build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Force and motion video Force and motion visuals Sentence stems: I notice….. I observed that…. My evidence is…. I learned/discovered/heard that

data are all necessary to help define the problem accurately. The most impactful situations to address are those that are relevant to the daily lives of students. Problems may include examples arising from what happens to plants/animals when the environment changes (e.g. Should plants in the classroom be taken home over the weekend/summer?), temperature fluctuations, cutting down trees to build new homes or selecting new trees to plant in an urban setting, pollution, water conditions in a local pond change, and the effects of drought on seasonal springs near the school. 2.ETS2.2 Engineers design the technologies that people use by applying knowledge of the natural world in an attempt to improve people's lives. Humans are dependent on our understanding of the natural world and on the materials we use from the natural world. Even objects that are not found in nature (e.g., spoons) are still products found in the natural world (e.g. metals). **Suggested Science and Engineering Practice(s)** Developing and Using Models Constructing Explanations and Designing Solutions **Suggested Crosscutting Concept(s)** Energy and Matter **Teacher Overview**		

Humans have used light to communicate for centuries. American Indians lit fires to send smoke-signal messages. Lighthouses along a coastline communicated warnings to ships of “rocky shore ahead.” Sailors aboard those ships used lantern signals to send messages to one another. Moreover, we all know Paul Revere’s famous message, “One if by land, two if by sea.” Over time, our use of light communication has increased. Take a look at a busy city, and you see flashing signs indicating places to eat or shop and traffic lights communicating to drivers and pedestrians. Signaling by light has been successfully used for rescue. Lost hikers or boaters bounce sunlight off a mirror or other shiny object, and rescuers high above in an airplane can see the flash. In normal sunlight, the flash from a good mirror is visible for 10–50 miles, depending on weather conditions. A good mirror will reflect moonlight and sunlight even on cloudy days. **Misconceptions** Students may think communication happens only with sound through speaking. Students may think light was used to communicate in the past but is no longer used. They may think that light can accompany communication with sound, but not be on its own. Students may not recognize written communication as communication with light.		