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

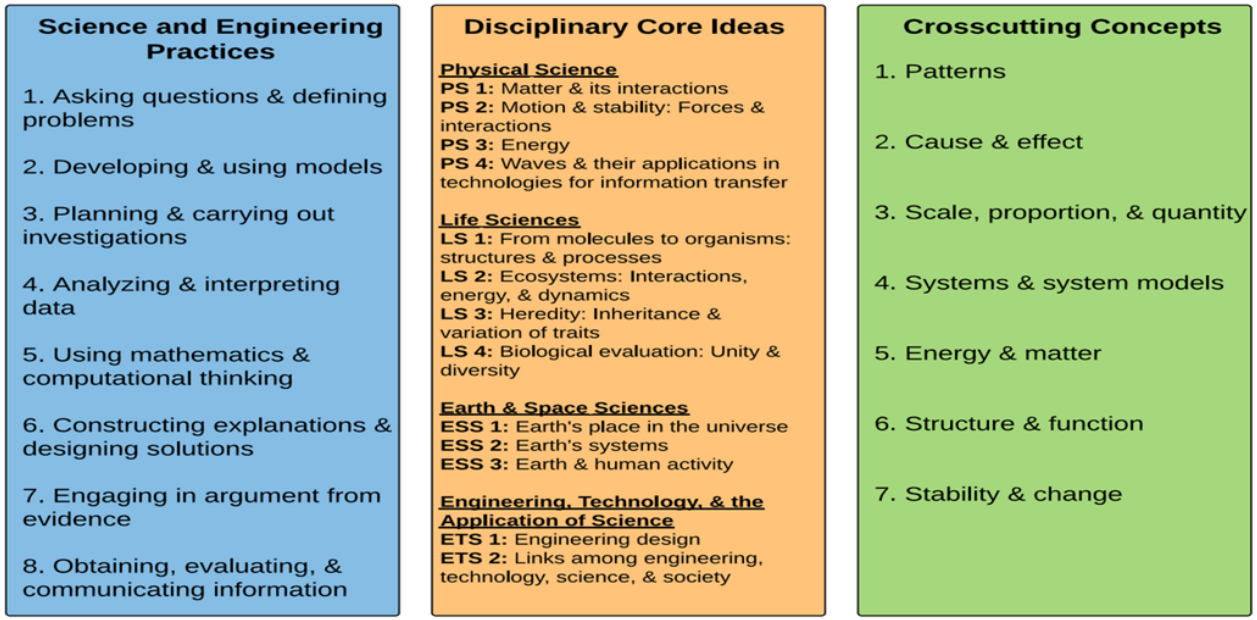
Science Education as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science classrooms. Thinking about science had become memorizing concepts and solving mathematical formulae. Practicing science had become prescribed 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.

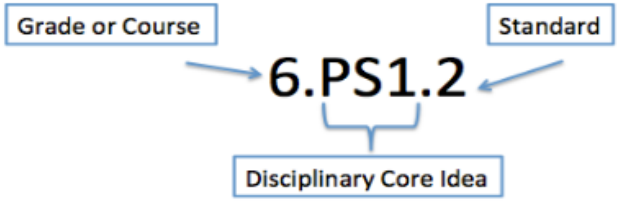
At the end of the middle school science experience, students can discover relationships by making observations and by the systematic gathering of data. They can identify relevant evidence and valid arguments. Their focus has shifted from the general to the specific and from the simple to the

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.

Physical Science
Quarter 4 Curriculum Map
Curriculum Map Feedback Survey

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

UNIT 7 Matter [4 weeks]

Overarching Question(s)

What causes waves to be different? How is wavelength related to speed and frequency?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 3	**Length** 4 Weeks	**Essential Questions** • How do waves transfer energy? • What are mechanical waves? • How do transfer waves differ from longitudinal waves? • How are wavelength and period related? • What is the relationship between frequency and wavelength?	Mechanical wave, medium, crest, trough, transverse wave, compression, rarefaction, longitudinal wave, surface wave, periodic motion, period, frequency, hertz, wavelength, amplitude, reflection, refraction, diffraction, interference, constructive interference, destructive interference, standing wave, joule, anti-mode, sound waves, intensity, decibel, loudness, pitch, sonar, Doppler effect, resonance

		• How do you calculate the speed of a wave? • What is the law of reflection? • Why do waves change direction when they travel from one material to another? • How are refraction and diffraction similar? How are they different? • What happen when waves interfere with each other?	
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
Disciplinary Core Ideas (DCI) PSCI.PS4: Waves and Their Applications in Technologies for Information Transfer **Standards** **PSCI.PS4.1** Use scientific reasoning to compare and contrast the properties of transverse and longitudinal waves and give examples of each type. **PSCI.PS4.2** Design/conduct an investigation and interpret gathered data to explain how mechanical waves transmit energy through a medium. **PSCI.PS4.3** Develop and use mathematical models to represent the properties of waves including frequency, amplitude, wavelength, and speed. **PS4.1 EXPLANATION:** Standard 4.PS4.1 is a student's introduction to waves. At this time, students address the properties of amplitude, wavelength and direction of a wave and principles of superposition of waves, but not by name. In 8.PS4.1, students learned that the speed of a wave is dependent on properties of the medium that the wave travels through. In a given medium, a specific		**Learning Outcomes** • Investigate the properties of waves using a variety of wave makers, such as ropes and springs. • Investigate and distinguish between the relationship between wavelength and frequency and amplitude. • Classify waves as transverse or longitudinal. • Distinguish between mechanical and electromagnetic waves. • Investigate factors that affect the speed of sound and compare and contrast sound and light waves. • • Use print and electronic resources to investigate the use of active noise reduction technology. • Design and conduct an investigation of wave • interactions while distinguishing among wave reflection, refraction, diffraction, and interference. **Phenomenon (Waves and Electromagnetic Spectrum)**	Engage Explore Explain Elaborate Evaluate **Curricular Resources** **Glencoe Physical Science - Chapter 9 Introduction to Waves** **9.1 The Nature of Waves - Teacher Edition (TE)** Caption Questions, TE pp. 275, 277, 278 Reading Checks, TE pp. 275, 276, 277 Launch Lab, TE p. 272 (5 min) Quick Demo, TE p. 275 (5 min)

type of wave will have a set speed. (e.g. the speed of sound is approximately 340m/s) Given that the speed of the wave is set, waves of differing frequencies will have different wavelengths, as these two factors describe the propagation of a wave. The amplitude of a wave is dependent on the amount of energy being transported by the wave. Students have diagrammed waves and labeled parts for both longitudinal and transverse waves in fourth grade while exploring interference patterns when two waves intersect. Students should now be performing quantitative analysis of wave behaviors. Students revisit the topic adding frequency to their models and beginning to consider wave speed, but without mentioning factors affecting the speed of the waves. At this time, discussion of rotational motion which can pair with discussions of simple harmonic motion to clarify angular velocity and angular speed. In PS4.1, students will use scientific reasoning to compare and contrast the properties of transverse and longitudinal waves and give examples of each type. Discussions regarding the origin of waves can fully develop these ideas. **PS4.2 EXPLANATION:** Standard 4.PS4.2 is a student's introduction to design and conducting investigation and interpreting and gathering data to explain how mechanical waves transmit energy through a medium. In 8.PS4.2 students learned that wave speed is dependent on the properties of the medium. Phenomena such as refraction occur when a wave travels out of one medium and into a different medium, resulting in a change to the wave speed. Regardless of type, waves are a means of transferring energy from one location to another. It is electromagnetic waves that carry energy from the sun to our planet. While sound waves travel through a medium, ultimately transferring	**View the phenomenon videos and choose which ones to show to students.** **The phenomenon of resonance - Sound Waves: 2:13 minutes:** **https://www.youtube.com/watch?v=yFsgu3ClqHo** **Wave phenomenon YouTube (10:42min)** **https://www.youtube.com/watch?v=a1NwwmzZ8NA** **Wave phenomenon YouTube (12:58min)** **https://www.youtube.com/watch?v=2dZymw0nr_s** **Standard Waves Phenomenon (5:49min)** **https://www.youtube.com/watch?v=leUm-L6eXH4** **View the phenomenon videos and choose which ones to show to students.** **Transverse Waves YouTube (4:39min)** **https://www.youtube.com/watch?v=-iO81v42dQA** **Transverse Waves and Longitudinal Waves YouTube (12:06 min)** **https://www.youtube.com/watch?v=jAXx0018QCc** **Mechanical Waves YouTube (5:42 min)** **https://www.youtube.com/watch?v=SNUNohhpwQs** **Mechanical Waves and Electromagnetic Waves YouTube (2:09 min)** **https://www.youtube.com/watch?v=93H1TY8uA9E** **What is a wave**: https://www.physicsclassroom.com/class/waves/Lesson-1/What-is-a-Wave	Khan Academy Introduction to waves (Time: 13:03 min.) **https://www.khanacademy.org/science/ap-physics-1/ap-mechanical-waves-and-sound/introduction-to-transverse-and-longitudinal-waves-ap/v/introduction-to-waves** **Work Review Problems** p. 278 **Quick Demo** Wave Motion TE p. 275 BrainPop Video on Waves (3:59 min) https://www.teachertube.com/video/waves-brainpop-405270 Demonstration Wave Energy TE p. 275 Visual Learning Animation (Water Waves) TE p. 276 Bozeman Science Waves https://www.youtube.com/watch?v=4S-MevRKGZs **9.2 Wave Properties - Teacher Edition (TE)** Caption Questions, TE pp. 281, 284 Reading Checks, TE pp. 280, 281 Mini Lab, TE p. 280 (10 min) Quick Demo, TE p. 281 (5 min) **Wave Properties** YouTube (12:07 min) https://www.youtube.com/watch?v=DEBpJk0ik2I Khan Academy Properties of Waves https://www.khanacademy.org/science/ap-physics-1/ap-mechanical-waves-and-sound/wave-characteristics-ap/v/amplitude-period-frequency-and-wavelength-of-periodic-waves

energy to ear drums creating the sensation of hearing. In PS4.2 students will design/conduct investigations and interpret gathered data to explain how mechanical waves transmit energy through a medium. **PS4.3 EXPLANATION:** Standard 4.PS4.3 students develop and use mathematical models to represent the properties of waves including frequency, amplitude, wavelength, and speed. The focus of this standard is on developing an understanding for the behavior of waves at a boundary. To demonstrate these principles, it is suggested that students create waves on a coiled spring or string and send these waves towards either a free or fixed end or through a different weight of string. For instance, wave can be created in a section of a lighter string then transmitted towards a point where that string terminates into a heavier segment of string. In doing so, it is possible to observe the effects on wave amplitude and a discussion of energy differences. Students should extend their observations of these mechanical waves to wave behaviors at other scales. In PS4.3, students will learn to develop and use mathematical models to represent the properties of waves including frequency, amplitude, wavelength, and speed. **Misconceptions** Identify Misconceptions – **Tsunamis –** Tsunamis are sometimes mistakenly called tidal waves, which may cause students to think they are related to tides. However, a tsunami is set off by an underwater geological disturbance, but tides are the result of gravitational interactions between Earth, the Moon, and the Sun. Ordinary waves are stirred up by wind. Point out to students that this is a good example of	**Anatomy of a wave:** https://www.physicsclassroom.com/class/waves/Lesson-2/The-Anatomy-of-a-Wave **Interactive Standing Wave:** https://www.physicsclassroom.com/Physics-Interactives/Waves-and-Sound/Standing-Wave-Patterns/Standing-Wave-Patterns-Interactive **The electromagnetic spectrum - Khan Academy Video (2:56 min**) https://www.khanacademy.org/partner-content/nova/sunandsolar/v/electromagneticspectrum	**BrainPOP Transverse Wave** TE p. 279 **Focus PREVIEW** TE p. 279 **Mini Lab** Observe the relationship between the wavelength and the frequency TE p. 280 **MiniLab** Interpret Data from a Slingshot TE p. 117 **Practice Problems** TE p. 282 **Make a Model** Penny Compressions TE p. 283 **Review Problems** TE p. 284 **9.3 Behavior of Waves - Teacher Edition (TE)** Caption Questions, TE pp. 286, 287, 288, 292, 294 Reading Check, TE pp. 290 Quick Demo, Observe Diffraction TE p. 290 (10 min) Quick Demo, Interference Effects TE p. 292 (10 min) MiniLab, TE p. 294 (10 min) **Focus Reading Preview** TE p. 286 **Teach** Caption Question Figure 13 TE p. 287 **Caption Question** Figure 15 TE p. 288 **Differentiated Instructions** TE p. 289 **MiniLab** Observe Standing Waves on a rope p. 294 **Review Problems** TE p. 295 Ted Ed **Light waves, visible and invisible (5:57min)** **https://www.youtube.com/watch?v=O0PawPSdk28**

the wide range of disturbances that can transfer energy by waves. Tsunamis Misconceptions https://blogs.agu.org/tremblingearth/2011/02/28/tsunami-misconceptions/ Myths about Tsunamis https://propertyid.com/article/view/973/myths-about-tsunamis Sound Waves vs. Radio Waves https://courses.lumenlearning.com/physics/chapter/introduction-11/ Resource: See Light & Optics / Waves & Sound https://rvenkatesh.weebly.com/misconceptions.html Sound Waves Video (10:42 min) https://www.youtube.com/watch?v=a1NwwmzZ8NA Sound Waves Misconceptions Video (3:07 min) https://www.youtube.com/watch?v=KJmHGspZrJI **Science & Engineering Practices** 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. 2. Developing and using models 5. Using mathematical and computational thinking. Constructing explanations and designing solutions		**Lessons** https://wolfriver.org/ecology **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

8. Obtaining, evaluating, and communicating information **Crosscutting Concepts** Scale, Proportion, and Quantity Students develop models to investigate scales that are beyond normal experiences 1. Pattern 2. Cause and effect 3. Scale, proportion, and quantity 5. Energy and matter		

Physical Science Quarter 4 Curriculum Map

Curriculum Map Feedback Survey

Quarter 1		Quarter 2	Quarter 3			Quarter 4	
Unit 1 Matter	Unit 2 Chemical Reactions	Unit 3 Motions 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 8 Matter [5 weeks]

Overarching Question(s)

What is electromagnetic radiation?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 8	5 Weeks	**Essential Questions** • How does a vibrating electric charge produce an electromagnetic wave? • What properties describe electromagnetic waves? • How do electromagnetic waves transfer energy? • What are the main division of the electromagnetic spectrum? • What are the properties of each type of electromagnetic wave? • What are some common uses of each type of electromagnetic wave?	Electromagnetic waves, radio waves, micro waves, infrared waves, visible light, ultraviolet waves, X-waves, gamma waves, carrier wave, modulation, analog signal, digital signal, transceiver, Global Positioning System (GPS)

		• How are carrier waves modulated to transmit information? • What is the difference between amplitude modulation and frequency modulation? • What technologies use radio waves and microwaves for communication?	

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI Disciplinary Core Ideas (**DCI)** **PS4:** Waves and Their Applications in Technologies for Information Transfer **Standards** **PS4.4** Describe and communicate the similarities and differences across the electromagnetic spectrum. Research methods and devices used to measure these characteristics. **PS4.5** Research and communicate scientific explanations about how electromagnetic waves are used in modern technology to produce, transmit, receive, and store information. Examples include: medical imaging, cell phones, and wireless networks. **PS4.4 EXPLANATION:** Standard 4.PS4.1 is a student's introduction to waves. At this time, students address the properties of amplitude, wavelength and direction of a wave and principles of superposition of waves, but not by name. Building on Standard 4.PS4.3, the behavior of a wave at a free or fixed boundaries can create patterns where successive waves produced by a source interact with those reflected off a boundary. Discussions should include general development of the idea of harmonics. The phenomena of resonance can be produced using a tuning fork held above a section of rigid tubing which is lowered or lifted into a pail of water. Resonance can be heard clearly at	**Learning Outcomes** • Distinguish between mechanical and electromagnetic waves. • Describe the effects of magnetic forces and magnetic fields and explain how magnetic poles determine the direction of magnetic force. • Describe Earth's magnetic field and its effect on compasses. • Describe how a moving electric charge creates a magnetic field and determine the direction of the magnetic field based on the type of charge and the direction of its motion. • Describe how electromagnetic devices use the interaction between electric currents and magnetic fields. **Phenomenon (Waves and Electromagnetic Spectrum)** **View the phenomenon videos and choose which ones to show to students.** **The phenomenon of resonance - Sound Waves: 2:13 minutes:** **https://www.youtube.com/watch?v=yFsgu3CIqHo** **Wave phenomenon YouTube (10:42min)** **https://www.youtube.com/watch?v=a1NwwmzZ8NA** **Wave phenomenon YouTube (12:58min)** **https://www.youtube.com/watch?v=2dZymw0nrs** **Standard Waves Phenomenon(5:49min)** **https://www.youtube.com/watch?v=leUm-L6eXH4**	Engage Explore Explain Elaborate Evaluate **Curricular Resources** **Glencoe Physical Science - Chapter 11 Electromagnetic Waves** **11.1 What are Electromagnetic Waves - Teacher Edition (TE)** Caption Question, TE p. 340 Reading Check, TE p. 338 Launch Lab, TE p. 336 (15 min) Quick Demo, Waves TE p. 339 (10 min) **1 Focus Reading Preview** (Magnets & Word Analysis) TE p. 338 **Visual Learning** Figure 3 TE p. 340 **Activity Drawing Waves** TE p. 341

multiple points, providing an opportunity to model the source of resonance and relate the resonance points to the wavelength of the wave produced. The phenomenon of beats can be used to provide an introduction to this topic as it too is an audible phenomenon. Quick demonstrations of beats can be performed without tuning forks using multiple open windows in a browser simultaneously playing different frequencies. In PS4.4, the students need to understand that the principal difference between wave types is the ability to propagate without a medium in the case of electromagnetic waves. However, even mechanical waves leave the medium undisturbed after passing through. (Students should be exposed to the varying frequencies for EM waves, but memorization of specific frequencies/wavelengths is not expected.) The focus of this discussion should be properties of the medium, specifically the density of the material. The density becomes a factor in optics and considering transmission of electromagnetic waves. Students can be led to make their descriptions by experimenting with coiled springs stretched to varying lengths. In PS4.4, students will describe and communicate the similarities and differences across the electromagnetic spectrum and research methods and devices used to measure these characteristics. **PS4.5 EXPLANATION:** The visible portion of the electromagnetic spectrum will be familiar to students, as will the ideas of x-rays, microwaves, and radiowaves. However, students often struggle to see these phenomena as multiple manifestations of the same principles. It may be beneficial to relate these discussions to the physiology of the human	**View the phenomenon videos and choose which ones to show to students.** **Transverse Waves YouTube (4:39min)** **https://www.youtube.com/watch?v=-iO81v42dQA** **Transverse Waves and Longitudinal Waves YouTube (12:06 min)** **https://www.youtube.com/watch?v=jAXx0018QCc** **Mechanical Waves YouTube (5:42 min)** **https://www.youtube.com/watch?v=SNUNohhpwQs** **Mechanical Waves and Electromagnetic Waves YouTube (2:09 min)** **https://www.youtube.com/watch?v=93H1TY8uA9E** **What is a wave**: https://www.physicsclassroom.com/class/waves/Lesson-1/What-is-a-Wave **Anatomy of a wave:** https://www.physicsclassroom.com/class/waves/Lesson-2/The-Anatomy-of-a-Wave **Interactive Standing Wave:** https://www.physicsclassroom.com/Physics-Interactives/Waves-and-Sound/Standing-Wave-Patterns/Standing-Wave-Patterns-Interactive **The electromagnetic spectrum - Khan Academy Video (2:56 min**) https://www.khanacademy.org/partner-content/nova/sunandsolar/v/electromagneticspectrum	**Mini Lab** Investigate Electromagnetic Waves TE p. 342 **Review Problems** TE p. 343 **YouTube Video** Electromagnetic Spectrum (13:20 min) https://www.youtube.com/watch?v=sJ7E6WOz8kA **Khan Academy Video** Electromagnetic Waves https://www.khanacademy.org/science/physics/light-waves/introduction-to-light-waves/v/electromagnetic-waves-and-the-electromagnetic-spectrum **Teacher's Pet -** The Flow of Energy: Heat https://www.youtube.com/watch?v=6fPnLKbf-3g **Bozeman Science** – Light (8:43 min) https://www.youtube.com/watch?v=l024MxO3AF0&feature=youtu.be **YouTube** Light (3:55 min) https://www.youtube.com/watch?v=pj_ya0e20vE **11.2 The Electromagnetic Spectrum - Teacher Edition (TE)** Caption Question, TE p. 348 Reading Check, TE p. 347 Inquiry Lab, TE p. 348 (3-4 class sessions) Quick Demo, TE p. 349 Visible Light Waves TE p. 349 (5 min) **Demonstration** Fluorescing Rocks TE p. 349 **MiniLab** Investigate the effects of microwaves TE p. 347

eye, specifically the function of the rhodopsin photopigment. As a demonstration: the light bulbs on the front of remote controls emit light outside of the visible spectrum; however, inexpensive cell phone cameras lack IR filters (as well as some front facing cameras on more current cell phones). Rendering the IR light visible can help student to understand that many devices function by capturing the energy of electromagnetic waves. In PS4.5, students will research and communicate scientific explanations about how electromagnetic waves are used in modern technology to produce, transmit, receive, and store information. Examples include: medical imaging, cell phones, and wireless networks. **Misconceptions** Myth vs. Realities about Light http://amazingspace.org/resource_page/157/electromagnetic/type Misconceptions and Proper Conceptions about Waves & Light https://www.scribd.com/document/183516086/Misconceptions-and-Proper-Conceptions Misconceptions about Light http://www.smallerquestions.org/blog/2011/12/3/on-invisible-misconceptions.html **Science & Engineering Practices** **Obtaining, evaluating, and communicating information** Students can provide written and oral		**Virtual Lab** What is the electromagnetic spectrum TE p. 345 **Khan Academy** **The Electromagnetic Spectrum** Video (11:02 min) https://www.khanacademy.org/science/physics/light-waves/introduction-to-light-waves/v/electromagnetic-waves-and-the-electromagnetic-spectrum **Khan Academy** **Introduction to Light** Video (9:36 min) https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms/bohr-model-hydrogen/v/introduction-to-light TedEd **Radio Waves** (4:23 min) Is light a particle or a wave https://www.youtube.com/watch?v=J1yIApZtLos **11.3 Radio Communication - Teacher Edition (TE)** Quick Demo, TE Radio Check TE p. 353 (10 min) **1 Focus Reading Preview** (Communication & Make Connections) TE p. 352 **Activity** Wave Skit TE p. 354 **Activity** (GEO vs. GPS) TE p. 356 **Review Problems** TE p. 357 TedEd **Radio Waves (3:03 min)** https://www.youtube.com/watch?v=zuM0VHWk2i8

explanations for phenomena and multipart systems using models, graphs, data tables, and diagrams. 6. Constructing explanations 8. Obtaining, evaluating, and communicating information **Crosscutting Concepts** **Pattern** Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations. 4. System and system models **Activities/Performance Tasks** **Included in the Curricular Resources**		**Khan Academy** Radio Waves (3:39 min) https://www.khanacademy.org/partner-content/nasa/measuringuniverse/spectroscopy/v/tour-of-the-ems-02-radio-waves **Khan Academy** Wireless Technology (5:38 min) https://www.khanacademy.org/partner-content/49ers-steam/ka-videos-topic/ka-videos-tutorial/v/wireless-technology **Additional Resources** **Performance Tasks (Science and Engineering Practices)** **Explain a Sequence –** Imagine you are floating in a wave pool. The crest of one wave hits you from the left just as the crest of another hits you from the right. The two waves are otherwise identical. A friend takes a series of five photos starting when the crest hit you. Write a paragraph describing the photos. (SEP 8) **A Tsunami, Where?** Tsunamis Article: Facts About Killer Waves. https://news.nationalgeographic.com/news/2005/01/tsunamis-facts-about-killer-waves/ Students will read the entire article and complete the following tasks. Look at the wave properties diagram in the Dig Deeper. Write a narrative telling what it shows. use your own words. How does it help explain the news article that you read on page 1? Use words to explain time or sequence, as needed. (SEP 8) **Are Regulations Needed to Protect Whales from Noise Pollution? Issues in Science** http://www.phschool.com/webcodes10/index.cfm?wcprefix=cch&wcsuffix=2173&area=view (visit:

		PHSchool.com; Web Code cch-2173). Students will read the viewpoints on p. 513 and write an argument for the viewpoint that they find is most convincing. (SEP 8) Types of Waves – Graphic Organizer – Students will make a graphic organizer to compare and contrast two types of waves. (SEP 8) Integrate Social Studies – Deadly Ocean Waves – Tsunamis can cause serious damage when they hit land. These waves can measure up to 30 m tall and can travel faster than 700km/h. Research to find which areas of the world are most vulnerable to tsunamis. Describe the effects that have occurred in these areas. (Web site Resource https://www.yahoo.com/lifestyle/deadly-waves-which-places-are-most-at-risk-for-a-071704375.html)(SEP 8) **Mechanical Waves** Students will prepare a PowerPoint to introduce the mechanical waves. (SEP8) Use this PowerPoint as an example: https://webcache.googleusercontent.com/search?q=cache:ZZuWAOGw2_0J:https://www.slideshare.net/kleybf/mechanical-waves+&cd=3&hl=en&ct=clnk&gl=us **Science and History – Making Waves** Students will research how sonar was used by navies in World War I and World War II. Did sonar affect each war's outcome? How did it save lives? What uses can you think of for sonar if it could be used in everyday life? Student will prepare a brief paper to explain their answers to the questions above. (SEP 8). (Web-site Resource: https://www.ww2sci-tech.org/lessons/lessons3.html). Law of Reflection Students will use the Law of Reflection to explain why you see only a portion of the area behind you when you look in a mirror. Student will give a written explanation and a diagram explaining their reasoning. (SEP 2, 8) (Web-site Resource:

		https://www.khanacademy.org/science/in-in-class10th-physics/in-in-10th-physics-light-reflection-refraction/in-in-reflection-of-light/v/laws-of-reflection2). Form a Hypothesis In 1981, people dancing on the balconies of a Kansas City, Missouri hotel caused the balconies to collapse. Use what you have learned about wave behavior to form a hypothesis that explains why this happened. (SEP 8). (Web-site: Resource http://pmsymposium.umd.edu/pm2017/wp-content/uploads/sites/3/2017/01/Schulman_Hyatt-Regency-Hotel-Walkway-Collapse.pdf) **Performance Tasks Electromagnetic Waves** Students will write one paragraph each about three different kinds of electromagnetic waves that they will encounter today. Use a single characteristic, such as wavelength of frequency to describe each wave. Explain how life might be different without each kind of wave. (SEP 8) Connecting Concepts – Mechanical Waves – Review the behaviors of mechanical waves discussed in the chapter, such as reflection and refraction. Compare them with the behavior of light. (SEP 8) Explain a Concept – Students will write a letter to a friend who is not in their class. They will explain how an object gets it color. They will give evidence and use examples to support their explanation. (SEP 8) Electromagnetic Waves – Graphic Organizers – Students will make a graphic organizer to help them understand electromagnetic waves. (SEP 8) **Integrating Health CT Scans –** In certain situations, doctors will perform a CT scan on a patient instead of a traditional X ray. Research to find out more about CT scans. Compare and contrast CT scans with X rays. What are the advantages and disadvantages of a CT scan? Write a paragraph about your findings.

		(SEP 8) Time - Science and History – Riding a Beam of Light – Students will read the article on p. 376. They will research the life of Albert Einstein and make a timeline showing important events in his life. They will also, include on their timeline major historical events that occurred during Einstein's lifetime. (SEP 8) **Additional Resources** **Student Activities** NASA sponsored site that allows students to learn more about the electromagnetic spectrum. http://spaceplace.nasa.gov/ir-photo-album/en/ Interactive website where the students experiment with light to produce images. www.learner.org/teacherslab/science/light/ The lab activities described in this document explore the properties of waves. http://mypages.iit.edu/~smile/ph9403.html Students explore why mint lifesavers glow in the dark- http://discoverykids.com/activities/light-up-lifesavers/ Observe and measure transverse, longitudinal, and combined waves on a model of a spring moved by a hand. Adjust the amplitude and frequency of the hand, and the tension and density of the spring. The speed and power of the waves is reported, and the wavelength and amplitude can be measured.

		http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=1053 Watch a string vibrate in slow motion. Wiggle the end of the string and make waves, or adjust the frequency and amplitude of an oscillator. Adjust the damping and tension. The end can be fixed, loose, or open. Download or run this simulation at http://phet.colorado.edu/en/simulation/wave-on-a-string https://www.scienceproject.com/projects/index/Senior/physics.asp Acoustics in buildings concerns controlling the quality and amount of sound inside a building. It is used to allow for pleasant sound in a concert hall and to reduce echoes and noise within an office building. Acoustics also concerns suppressing sound coming from outside the building, such as in apartments. http://www.school-forhttp://www.school-for-champions.com/science/sound_building_acoustics.htmchampions.com/science/sound_building_acoustics.htm A printable worksheet on longitudinal and transverse waves is provided at http://sciencenetlinks.com/lessons/properties-sound-waves/ Find cool teacher demos using this website! http://www.exploratorium.edu/snacks/iconlight.html Additional project ideas are provided that may be used during your study of optics as extensions to the other activities. These enrichment opportunities will

		help you learn more about the human eye, vision problems, ophthalmology, the design of optical devices, and the history of theories involving light and its properties. http://micro.magnet.fsu.edu/optics/activities/students/projectideas.html Supports CCSS!!! www.readworks.org **(FREE REGISTRATION) (The Sounds of Baseball, Digitized Signals are the Future of the Black Box, using cellphones and computers to Transmit Information)** The Physic Front: http://www.compadre.org/precollege/static/unit.cfm?sb=8&course=5 **Lessons** https://wolfriver.org/ecology **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Quarter 3		**Physical Science**	
Textbook Resources	**DCIs and Standards** **DCI** **Standard**	**Websites/Videos**	**ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The Teaching Channel Teachertube.com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