Shelby County Schools Science Vision

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

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

Introduction

In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we must collectively work to provide our students with high quality standards aligned instruction. The Tennessee Academic Standards for Science provide a common set of expectations for what students will know and be able to do at the end of each grade, can be located in the Tennessee Science Standards Reference. Tennessee Academic Standards for Science are rooted in the knowledge and skills that students need to succeed in post-secondary study or careers. While the academic standards establish desired learning outcomes, the curricula provides instructional planning designed to help students reach these outcomes. The curriculum maps contain components to ensure that instruction focuses students toward college and career readiness. Educators will use this guide and the standards as a roadmap for curriculum and instruction. The sequence of learning is strategically positioned so that necessary foundational skills are spiraled in order to facilitate student mastery of the standards.

Our collective goal is to ensure our students graduate ready for college and career. Being College and Career Ready entails, many aspects of teaching and learning. We want our students to apply their scientific learning in the classroom and beyond. These valuable experiences include students being facilitators of their own learning through problem solving and thinking critically. The Science and Engineering Practices are valuable tools used by students to engage in understanding how scientific knowledge develops. These practices rest on important "processes and proficiencies" with longstanding importance in science education. The science maps contain components to ensure that instruction focuses students toward understanding how science and engineering can contribute to meeting many of the major challenges that confront society today. The maps are centered around five basic components: the Tennessee Academic Standards for Science, Science and Engineering Practices, Disciplinary Core Ideas, Crosscutting Concepts, and Phenomena.

The Tennessee Academic Standards for Science were developed using the National Research Council's 2012 publication, [A Framework for K-12 Science Education] as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science classrooms. Thinking about science had become memorizing concepts and solving mathematical formulae. Practicing science had become prescribed lab situations with predetermined outcomes. The framework proposes a three-dimensional approach to science education that capitalizes on a child's natural curiosity. The Science Framework for K-12 Science Education provides the blueprint for developing the effective science practices. The *Framework* expresses a vision in science education that requires students to operate at the nexus of three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The *Framework* identified a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve. Key to the vision expressed in the *Framework* is for students to learn these disciplinary core ideas in the context of science and engineering practices. The importance of combining Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas is stated in the *Framework* as follows:

Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content. (NRC Framework, 2012, p. 218)

To develop the skills and dispositions to use scientific and engineering practices needed to further their learning and to solve problems, students need to experience instruction in which they use multiple practices in developing a particular core idea and apply each practice in the context of multiple core ideas. We use the term "practices" instead of a term such as "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Students in grades K-12 should engage in all eight practices over each grade band**.** Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. There are seven crosscutting concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world.

The map is meant to support effective planning and instruction to rigorous standards. It is *not* meant to replace teacher planning, prescribe pacing or instructional practice. In fact, our goal is not to merely "cover the curriculum," but rather to "uncover" it by developing students' deep understanding of the content and mastery of the standards. Teachers who are knowledgeable about and intentionally align the learning target (standards and objectives), topic, text(s), task, and needs (and assessment) of the learners are best-positioned to make decisions about how to support student learning toward such mastery.

Teachers are therefore expected--with the support of their colleagues, coaches, leaders, and other support providers--to exercise their professional judgment aligned to our shared vision of effective instruction, the Teacher Effectiveness Measure (TEM) and related best practices. However, while the framework allows for flexibility and encourages each teacher/teacher team to make it their own, our expectations for student learning are non-negotiable. We must ensure all of our children have access to rigor—high-quality teaching and learning to grade level specific standards, including purposeful support of literacy and language learning across the content areas.

Science and Engineering Practices

1. Asking questions & defining problems
2. Developing & using models
3. Planning & carrying out investigations
4. Analyzing & interpreting data
5. Using mathematics & computational thinking
6. Constructing explanations & designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, & communicating information

Disciplinary Core Ideas

Physical Science
PS 1: Matter & its interactions
PS 2: Motion & stability: Forces & interactions
PS 3: Energy
PS 4: Waves & their applications in technologies for information transfer

Life Sciences
LS 1: From molecules to organisms: structures & processes
LS 2: Ecosystems: Interactions, energy, & dynamics
LS 3: Heredity: Inheritance & variation of traits
LS 4: Biological evaluation: Unity & diversity

Earth & Space Sciences
ESS 1: Earth's place in the universe
ESS 2: Earth's systems
ESS 3: Earth & human activity

Engineering, Technology, & the Application of Science
ETS 1: Engineering design
ETS 2: Links among engineering, technology, science, & society

Crosscutting Concepts

1. Patterns
2. Cause & effect
3. Scale, proportion, & quantity
4. Systems & system models
5. Energy & matter
6. Structure & function
7. Stability & change

Learning Progression

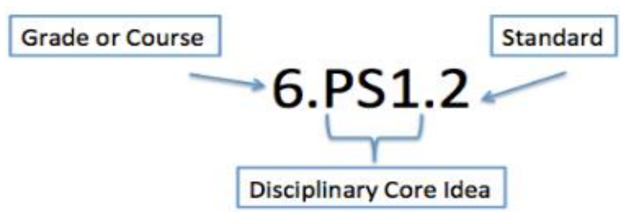
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain phenomena. Students can keep notebooks to record sequential observations and identify simple patterns. They are able to design and conduct investigations, analyze results, and communicate the results to others. Students will carry their curiosity, interest and enjoyment of the scientific world view, scientific inquiry, and the scientific enterprise into middle school.

At the end of the middle school science experience, students can discover relationships by making observations and by the systematic gathering of data. They can identify relevant evidence and valid arguments. Their focus has shifted from the general to the specific and from the simple to the complex. They use scientific information to make wise decision related to conservation of the natural world. They recognize that there are both negative and positive implications to new technologies.

As an SCS graduate, former students should be literate in science, understand key science ideas, aware that science and technology are interdependent human enterprises with strengths and limitations, familiar with the natural world and recognizes both its diversity and unity, and able to apply scientific knowledge and ways of thinking for individual and social purposes.

Structure of the Standards

- Grade Level/Course Overview: An overview that describes that specific content and themes for each grade level or high school course.
- Disciplinary Core Idea: Scientific and foundational ideas that permeate all grades and connect common themes that bridge scientific disciplines.
- Standard: Statements of what students can do to demonstrate knowledge of the conceptual understanding. Each performance indicator includes a specific science and engineering practice paired with the content knowledge and skills that students should demonstrate to meet the grade level or high school course standards.



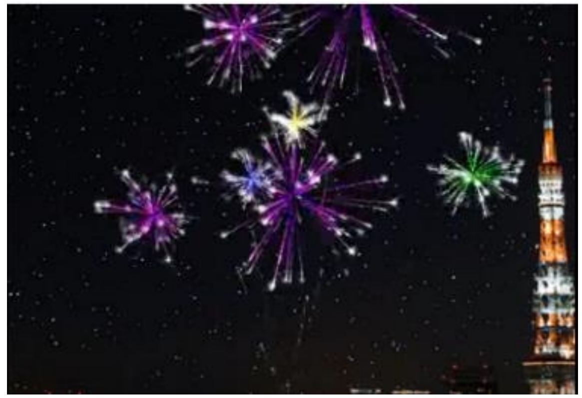
Purpose of Science Curriculum Maps

This map is a guide to help teachers and their support providers (e.g., coaches, leaders) on their path to effective, college and career ready (CCR) aligned instruction and our pursuit of Destination 2025. It is a resource for organizing instruction around the Tennessee Academic Standards for Science, which define what to teach and what students need to learn at each grade level. The map is designed to reinforce the grade/course-specific standards and content (scope) and provides *suggested* sequencing, pacing, time frames, and aligned resources. Our hope is that by curating and organizing a variety of standards-aligned resources, teachers will be able to spend less time wondering what to teach and searching for quality materials (though they may both select from and/or supplement those included here) and have more time to plan, teach, assess, and reflect with colleagues to continuously improve practice and best meet the needs of their students.

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

6th Grade Quarter 1 Curriculum Map Quarter 1 Curriculum Map Feedback								
Quarter 1		Quarter 2		Quarter 3				Quarter 4
Structures & Routines	**Unit 1 Energy**	Unit 2 Relationships Among Organisms	Unit 3 Earth's Biomes and Ecosystems	Unit 4 Earth's Resources	Unit 5 Human Impact on the Environment	Unit 6 Earth's Water	Unit 7 Earth's Systems	Unit 8 Weather and Climate
1 week	**8 weeks**	4 weeks	5 weeks	3 weeks	2 weeks	1 week	3 weeks	9 weeks

UNIT 1: Energy (8 weeks)			
Overarching Question(s)			
How is energy transferred and conserved?			
Unit 1, Lesson 1	**Lesson Length**	**Essential Question**	**Vocabulary**
Introduction to Energy	2.5 weeks	What is energy?	energy, kinetic energy, potential energy, energy transformation, law of conservation of energy
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
DCI(s) PS3: Energy **Standard(s)** 6.PS3.1 Analyze the properties and compare the sources of kinetic, elastic potential, gravitational potential, electric potential, chemical, and thermal energy. 6.PS3.2 Construct a scientific explanation of the transformation between potential and kinetic energy.		**Learning Outcomes** • Compare and give examples of kinetic and potential energy. • Classify an object's energy as either kinetic energy, potential energy, or both. • Describe mechanical energy. • Describe different forms of energy. • Describe examples of different forms of energy. • Describe the Law of Conservation of Energy being converted from one form to another.	**Curricular Materials** HMH Tennessee Science TE, Unit 1, Lesson 1 pp. 10-23 Engage • Engage Your Brain #s 1 and 2, SE p. 5 • Active Reading #s 3 and 4, SE p. 5 Explore Kinetic and Potential Energy • Setting Objects in Motion Quick Lab, TE p. 13 • Bungee Jumping Quick Lab, TE p. 13 • Designing a Simple Device S.T.E.M. Lab, TE p. 13 The Law of Conservation of Energy

Explanation(s) and Support of Standard (s) [from TN Science Reference Guide] 6.PS3.1 A system contains energy if some objects in the system are moving, or if the system possesses stored energy. Energy due to the motion of large objects is known as kinetic energy. Thermal energy is energy due to the total amount of motion of the particles in a material. Energy that is stored by a system is called potential energy. Specifically, a system stores elastic potential energy when a force stretches an object that can be deformed (spring, rubber band). Gravitational potential energy is stored by a gravitational field when a force moves an object through the gravitational field (e.g., lifted upwards). Electric potential stores energy when a force moves one charged particle across the electric field produced by another charged particle. For any of the above examples, more energy is stored when the force moves the object a greater distance. (E.g., stretching a spring further stores more elastic potential energy) When different components are listed in the description of a system, the system will have different energy types. For example, a system which includes the Earth and a falling ball possess both kinetic energy and gravitational potential energy. If the Earth is not included, the system cannot contain	**Suggested Phenomenon**  Click on the picture to show the fireworks explosion. The solid chemicals packed into the cardboard case don't simply rearrange themselves into other chemicals: some of the chemical energy locked inside them is converted into four other kinds of energy (heat, light, sound, and the kinetic energy of movement). Students can complete a See Think Wonder Template while viewing the video.	• Diagramming Mechanical Energy Activity, TE p. 12 • Conservation of Energy Quick Lab, TE p. 13 Explain Kinetic and Potential Energy • Active Reading #5, SE p. 6 • Think Outside the Book #6, SE p. 7 • Analyze #7, SE p. 7 Forms of Energy • Visualize It! #8, SE p. 8 • Compare #9, SE p. 9 • Infer #10, SE p. 9 • Active Reading #11, SE p. 10 • Synthesize #12, SE p. 10 The Law of Conservation of Energy • Visualize It! #16, SE p. 12 • Active Reading #17, SE p. 13 • Think Outside the Book #18, SE p. 13 • Describe #19, SE p. 13 Extend Reinforce and Review • The Law of Conservation of Energy Process Chart, TE p. 16 • Visual Summary, SE p. 14 Going Further • Space Science Connection, TE p. 16 • Why It Matters, SE p. 11 Evaluate Formative Assessment

gravitational potential energy, because that would require Earth's gravitational field. 6.PS3.2 The role of forces: If we see that the motion of an object is changing, we know that kinetic energy of the object is increasing or decreasing and that there must be a force causing the change to the motion of the object (5.PS2.1). Therefore, forces are ways to transfer energy to or from an object. Potential energy can be transferred to kinetic energy when an object storing potential energy exerts a force. For example, when a person pulls back a slingshot, the force they exert on the elastic bands stores elastic potential energy (6.PS3.1). If the person releases the slingshot, the elastic potential energy stored in the bands allows the bands to exert a force on the projectile, which builds the kinetic energy of the projectile. Transfers of kinetic energy to potential energy are also possible. For example, when we see that a ball thrown straight upwards begins to slow down as it reaches its highest height, we know that its kinetic energy is decreasing. Kinetic energy has been transferred from the ball and is becoming potential energy, stored in the Earth's gravitational field.		• Reteach, TE p. 17 • Throughout TE • Lesson Review, SE p. 15 Summative Assessment • Energy Alternative Assessment, TE p. 17 • Lesson Quiz **Additional Resources** • Energy of Motion Curricular Unit • 6.PS3.2 Student Activity and Teacher Guide • Scientists Say: Kinetic Energy • Legends of Learning-Kinetic Energy • Legends of Learning-Potential Energy • National Energy Education Development Project • Using Rube Goldberg Contraptions to Introduce Forms of Energy Better Lesson • Ping Pong Catapult Science Buddies Lesson **ESL Supports and Scaffolds** WIDA Standard 4 - The Language of Science To support students in speaking, refer to this resource: WIDA Doing and Talking Science Sample Language Objectives: (language domain along with a scaffold)

Suggested Science and Engineering Practice(s) Developing and Using Models 6.PS3.1 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. Planning and Carrying Out Controlled Investigations 6.PS3.2 Students begin to investigate independently, select appropriate independent variables to explore a dependent variable and recognize the value of failure and revision in the experimental process. **Suggested Crosscutting Concept(s)** Energy and Matter 6.PS3.1 Students give general descriptions of different forms and mechanisms for energy storage within a system. Stability and Change 6.PS3.2 Students explain that systems in motion or dynamic equilibrium can be stable.		• Students will complete a graphic organizer to compare kinetic and potential energy using sentence frames and a word bank. • Students will work with a partner to classify an object's energy as either kinetic energy, potential energy, or both using sentence frames and a three-tiered chart. • Students will write to describe mechanical energy using a word bank. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) conservation, visual/visualize, process (as a noun), source, construct Use graphic organizers or concept maps to support students in their analysis of types of energy or compare/contrast sources Use relationship verbs such as contain, consist of. as, then. When I changed, then happened. The more/less, then. Provide compare/contrast sentence stems: This is the same as, because. This is different than, because. All these are because . , and all have/are .

		When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals To support students with the scientific explanation: Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Question Starters What's the connection between….? What link do you see between… Why do you think…? What is our evidence that…. Do we have enough evidence to make that claim? But what about this other evidence that shows…? But does your claim account for…(evidence) Response Starters I agree with you because of (evidence or reasoning) I don't agree with your claim because of (evidence or reasoning) This evidence shows that… Your explanation makes me think about …..

6th Grade Quarter 1 Curriculum Map Quarter 1 Curriculum Map Feedback								
Quarter 1		Quarter 2		Quarter 3				Quarter 4
Structures & Routines	**Unit 1 Energy**	Unit 2 Relationships Among Organisms	Unit 3 Earth's Biomes and Ecosystems	Unit 4 Earth's Resources	Unit 5 Human Impact on the Environment	Unit 6 Earth's Water	Unit 7 Earth's Systems	Unit 8 Weather and Climate
1 week	**8 weeks**	4 weeks	5 weeks	3 weeks	2 weeks	1 week	3 weeks	9 weeks

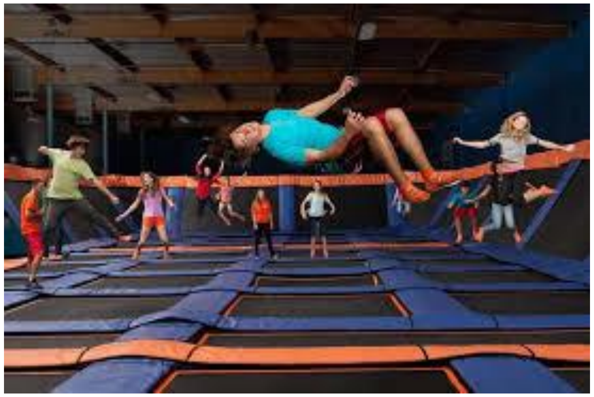
UNIT 1: Energy (8 weeks)

Overarching Question(s)

How is energy transferred and conserved?

Unit 1, Lesson 2	Lesson Length	Essential Question	Vocabulary
Kinetic and Potential Energy	2.5 weeks	What is energy?	potential energy, kinetic energy, mechanical energy

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) PS3: Energy **Standard(s)** 6.PS3.1 Analyze the properties and compare the sources of kinetic, elastic potential, gravitational potential, electric potential, chemical, and thermal energy. 6.PS3.2 Construct a scientific explanation of the transformation between potential and kinetic energy.	**Learning Outcomes** • Describe/explain examples of kinetic energy. • Describe/explain examples of potential energy.	**Curricular Resources** HMH Tennessee Science TE, Unit 1, Lesson 2 pp. 24-36 Engage • Engage Your Brain #s 1 and 2, SE p. 19 • Active Reading #3, SE p. 19 Explore Kinetic Energy • Identify Potential and Kinetic Energy Quick Lab, TE p. 27 • Energy of a Tennis Ball Activity, TE p. 26 • Kinetic Energy Virtual Lab, TE p. 27 Potential Energy

6.PS3.3 Analyze and interpret data to show the relationship between kinetic energy and the mass of an object and its speed. **Explanation(s)and Support of Standard(s) from TN Science Reference Guide** 6.PS3.1 A system contains energy if some objects in the system are moving, or if the system possesses stored energy. Energy due to the motion of large objects is known as kinetic energy. Thermal energy is energy due to the total amount of motion of the particles in a material. Energy that is stored by a system is called potential energy. Specifically, a system stores elastic potential energy when a force stretches an object that can be deformed (spring, rubber band). Gravitational potential energy is stored by a gravitational field when a force moves an object through the gravitational field (e.g., lifted upwards). Electric potential stores energy when a force moves one charged particle across the electric field produced by another charged particle. For any of the above examples, more energy is stored when the force moves the object a greater distance. (E.g., stretching a spring further stores more elastic potential energy) When different components are listed in the description of a system, the system will have different energy types. For example, a system which	**Suggested Phenomenon**  Potential energy and kinetic energy are the reason trampolines allow you to jump higher than you can on flat ground. One type of potential energy that is involved with trampolines is the elastic potential energy stored in springs. Another type of energy is gravitational potential energy. This can be described under the big umbrella of kinetic energy because of the people being in motion. Click on the image to view the video clip. Students can complete a See Think Wonder Template while viewing the video.	• Investigate Potential Energy Quick Lab, TE p. 27 Mechanical Energy • Roller Coaster Ride Daily Demo, TE p. 27 • Mechanical Energy Exploration Lab, TE p. 27 Explain Kinetic Energy • Active Reading #5, SE p. 20 • Visualize It! #6, SE p. 20 Potential Energy • Think Outside the Book #8, SE p. 22 • Visualize It! #9, SE p. 22 Mechanical Energy • Active Reading #11, SE p. 24 • Visualize It! #12, SE p. 24 • Analyze #13, SE p. 24 Extend Reinforce and Review • Word Triangles Graphic Organizer, TE p. 30 • Visual Summary, SE p.26 Going Further • Physical Education Connection, TE p. 30 • Real-World Connection, TE p. 30 Evaluate Formative Assessment • Reteach, TE p. 31 • Throughout TE • Lesson Review, SE p. 27 Summative Assessment

includes the Earth and a falling ball possess both kinetic energy and gravitational potential energy. If the Earth is not included, the system cannot contain gravitational potential energy, because that would require Earth's gravitational field. 6.PS3.2 The role of forces: If we see that the motion of an object is changing, we know that kinetic energy of the object is increasing or decreasing and that there must be a force causing the change to the motion of the object (5.PS2.1). Therefore, forces are ways to transfer energy to or from an object. Potential energy can be transferred to kinetic energy when an object storing potential energy exerts a force. For example, when a person pulls back a slingshot, the force they exert on the elastic bands stores elastic potential energy (6.PS3.1). If the person releases the slingshot, the elastic potential energy stored in the bands allows the bands to exert a force on the projectile, which builds the kinetic energy of the projectile. Transfers of kinetic energy to potential energy are also possible. For example, when we see that a ball thrown straight upwards begins to slow down as it reaches its highest height, we know that its kinetic energy is decreasing. Kinetic energy has been transferred from the ball and is becoming potential energy, stored in the Earth's gravitational field.		• Kinetic and Potential Energy Alternative Assessment, TE p. 31 • Lesson Quiz **Additional Resources** • Energy & Matter STUDY JAMS! Video • TeachEngineering: Physics of Roller Coasters • TeachEngineering: Exploring Energy: What is Energy? • 6.PS3.2 Student Activity and Teacher Guide • 6.PS3.3 Student Activity and Teacher Guide • National Energy Education Development Project • Using Roller Coasters to Introduce Energy Better Lesson • Using Crosscutting Concepts to Analyze Roller Coaster Data Better Lesson • Investigating How Bouncing Balls and Roller Coasters are Related Better Lesson • Potential and Kinetic Energy Better Lesson • Energy Skate Park PhET Interactive Simulation • Mechanical Energy and Mass Better Lesson • Paper Roller Coaster: Kinetic and Potential Energy Science Buddies Lesson • Balloon Car Science Buddies Lesson • Teaching Engineering Design with an Egg Drop Science Buddies Lesson • Over the Hill Exploratorium Science Snack • Downhill Race Exploratorium Science Snack

6.PS3.3 Typically, scientists would determine the relationships between these properties using graphs. However, students in 6th grade have not yet covered the necessary graphing concepts. Instead, students can show the relationships using ratios. The ratio of change to mass to change in kinetic energy will be a constant ratio, however, the ratio of change in speed to change in kinetic energy will not be a constant ratio. In other words, if the mass of an object is doubled, the kinetic energy will also double. However, if the speed of an object doubles, the kinetic energy will more than double. If the speed doubles, the kinetic energy will increase four times. If the speed triples, the kinetic energy will increase to nine times its initial value. Students are likely to recognize this increase as squaring given (6.EE.A.1). **Suggested Science and Engineering Practice(s)** Developing and Using Models 6.PS3.1 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. Planning and Carrying Out Controlled Investigations 6.PS3.2 Students begin to investigate independently, select appropriate independent variables to explore a		• Bottle Racer Exploratorium Science Snack • Stomp Rockets Classroom Activity **ESL Supports and Scaffolds** WIDA Standard 4 - The Language of Science To support students in speaking, refer to this resource: WIDA Doing and Talking Science Sample Language Objectives: (language domain along with a scaffold) • Students will describe/explain examples of kinetic energy to a partner using the words…. • Students will describe/explain examples of potential energy using a graphic organizer and word box. When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Pre-teach vocabulary – (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) energy, forces, fields, pulled back, storage, transformation

dependent variable and recognize the value of failure and revision in the experimental process. <u>Analyzing and Interpreting Data</u> 6.PS3.3 Students should create and analyze graphical presentations of data to identify linear and non-linear relationships, consider statistical features within data and evaluate multiple data sets for a single phenomenon. **Suggested Crosscutting Concept(s)** <u>Energy and Matter</u> 6.PS3.1 Students give general descriptions of different forms and mechanisms for energy storage within a system. <u>Stability and Change</u> 6.PS3.2 Students explain that systems in motion or dynamic equilibrium can be stable. <u>Scale, Proportion, and Quantity</u> 6.PS3.3 Students make and evaluate derived/proportional measurements.		Use relationship verbs such as contain, consist of. As, then. When I changed, then happened. The more/less, then . Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Provide compare/contrast sentence stems: This is the same as, because... This is different than, because... All these are, because … , and all have/are . To support students with the scientific explanation: <u>Question Starters</u> What's the connection between….? What link do you see between… Why do you think…? What is our evidence that…. Do we have enough evidence to make that claim? But what about this other evidence that shows..? But does your claim account for…(evidence) <u>Response Starters</u> I agree with you because of (evidence or reasoning)

		I don’t agree with your claim because of (evidence or reasoning) This evidence shows that… Your explanation makes me think about …..

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Quarter 1		Quarter 2		Quarter 3				Quarter 4
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1 week	**8 weeks**	4 weeks	5 weeks	3 weeks	2 weeks	1 week	3 weeks	9 weeks

UNIT 1: Energy (8 weeks)			
Overarching Question(s)			
How is energy transferred and conserved?			
Unit 1, Lesson 3	**Lesson Length**	**Essential Question**	**Vocabulary**
Thermal Energy and Heat	3 weeks	What is energy? *What is the relationship between heat and temperature?*	thermal energy, heat, conduction, conductor, insulator, calorie, convection, radiation, temperature, degrees

Standards and Related Background Information	**Instructional Focus**	**Instructional Resources**
DCI(s) PS3: Energy ETS1: Engineering Design **Standard(s)** 6.PS3.1 Analyze the properties and compare the sources of kinetic, elastic potential, gravitational potential, electric potential, chemical, and thermal energy.	**Learning Outcomes** • Define thermal energy. • Differentiate between thermal energy and temperature. • Differentiate between heat and temperature. • Differentiate between heat and thermal energy. • Explain that adding heat to or removing heat from a system may result in a change of state. • Describe and provide examples of conduction, conductor, insulator, convection, and radiation.	**Curricular Resources** HMH Tennessee Science TE, Unit 1, Lesson 3 pp. 38-51 Engage • Engage Your Brain #s 1 and 2, SE p. 31 • Active Reading #s 3 and 4, SE p. 31 Thermal Energy • Thermal Energy in a Bottle Daily Demo, TE p. 40 Changes of State • Observing the Transfer of Energy Quick Lab, TE p. 40

6.PS3.4 Conduct an investigation to demonstrate the way that heat (thermal energy) moves among objects through radiation, conduction, or convection.

*6.ETS1.2 Design and test different solutions that impact energy transfer.

Explanation(s)and Support of Standard(s) [from TN Science Reference Guide]

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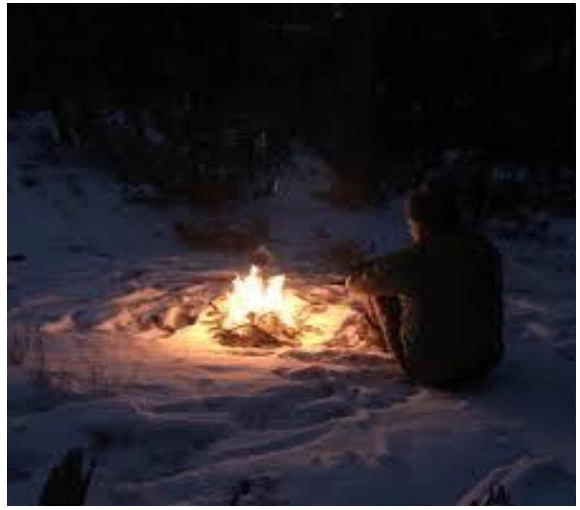
Specifically, a system stores elastic potential energy when a force stretches an object that can be deformed (spring, rubber band). Gravitational potential energy is stored by a gravitational field when a force moves an object through the gravitational field (e.g., lifted upwards). Electric potential stores energy when a force moves one charged particle across the electric field produced by another charged particle. For any of the above examples, more energy is stored when the force moves the object a greater distance. (E.g., stretching a spring further stores more elastic potential energy)

Suggested Phenomena



Heat is the movement of thermal energy from a warmer object to a cooler object. Thermal energy is the sum of the kinetic energy and potential energy in a material. Temperature represents the average kinetic energy in a material. This photo shows various forms of thermal energy transfers. For example, convection carries the flames and smoke from the fire upward. Air around the fire heats and rises. The ground under the fire will get hot, heated by conduction. Radiation from the fire heats the camper. Students can complete a See Think Wonder Template after examining the picture.

Explore

Methods of Thermal Energy Transfer
- Exploring Thermal Conductivity Quick Lab, TE p. 41
- Simple Heat Engine Quick Lab, TE p. 41

Explain

Thermal Energy
- Active Reading #5, SE p. 32
- Apply #6, SE p. 33
- Temperature and Thermal Energy, TE p. 41

Heat
- We're in Hot Water, TE p. 40
- Apply #7, SE p. 34
- Visualize It! #8, SE p. 35
- Active Reading #9, SE p. 35

Changes of State
- Heat Race Activity, TE p. 40
- Think Outside the Book #10, SE p. 36
- Active Reading #11, SE p. 36

Methods of Thermal Energy Transfer
- Classify #12, SE p. 37
- Active Reading #13, SE p. 38
- Classify #14, SE p. 38

Extend

Reinforce and Review
- Which Way Did the Energy Go? Activity, TE p. 44
- Visual Summary, SE p. 40

Going Further

When different components are listed in the description of a system, the system will have different energy types. For example, a system which includes the Earth and a falling ball possess both kinetic energy and gravitational potential energy. If the Earth is not included, the system cannot contain gravitational potential energy, because that would require Earth's gravitational field. 6.PS3.4 In everyday language, "heat" is used to refer to thermal energy (the motion of particles) and energy transfer. Students should comprehend the difference between these two uses, and understand that scientist only use the term heat when referencing energy transfer from one object to another. The colloquial use of "heat" to describe the amount of warmth an object possesses should be abandoned, in favor of the use of "thermal energy." Thermal energy is the total energy due to the movement of particles in a substance. Thermal energy is related to temperature which can be measured using a thermometer, however thermal energy must also account for mass of the sample. There are three specific means of heating: conduction, convection, and radiation. Radiation (infrared or visible light) can be seen as a form of heating, but is unique from conduction and		• Why It Matters, SE p. 39 Evaluate Formative Assessment • Reteach, TE p. 45 • Throughout TE • Lesson Review, SE p. 41 Summative Assessment • Thermal Energy and Its Transfer Alternative Assessment, TE p. 55 • Lesson Quiz **Additional Resources** • Heat STUDY JAMS! Video • Heat, Temperature, and Conduction Lesson • Cooking with the Sun - Creating a Solar Oven • Energy Skate Park Basics Energy Exploration • Atmospheric Process: Radiation Experiment • Save the Penguins Investigation • Pendulum Energy Simulation • 6.PS3.4 Student Activity , Teacher Guide, and Heat Transfer Viewing Guide • Conduction, Convection, and Radiation Teacher Demonstrations • Legends of Learning-Heat as Energy Transfer • Suit Up! Teach Engineering Activity • National Energy Education Development Project • Heat Transfer in Architecture: Convection Better Lesson

convection, because it can transfer energy across empty space. Students can observe changes in thermal energy (by recording temperature) or changes in state (by observing pure substances) using any of the above methods of heating. *6.ETS1.2 Even design solutions that meet criteria and constraints for a successful design may fail in production. The tests should be designed to expose failure in specific components of a device. The results of these tests can then be used to create a comprehensive solution. Design tasks might relate to selecting materials to minimize or maximize energy transfer into or out of a system by minimizing heat loss, or sound production or by maintaining initial kinetic energies. Not all design challenges require the creation of a physical device. For example, this standard could pair with other ESS standards on assessing human impacts, but address how a device operating the in the field might be powered. **Suggested Science and Engineering Practice(s)** Developing and Using Models 6.PS3.1 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.		• Heat Transfer in Architecture: Conduction Better Lesson • Heat Transfer in Architecture: Radiation Better Lesson • Build a Pizza Box Solar Oven Science Buddies STEM Activity **ESL Supports and Scaffolds** WIDA Standard 4 - The Language of Science To support students in speaking, refer to this resource: WIDA Doing and Talking Science Sample Language Objectives: (language domain along with a scaffold) • Students will write a definition of thermal energy using a sentence frame and word box. • Students will talk with a partner to differentiate between thermal energy and temperature using a compare/contrast graphic organizer • Students will write a definition of heat and calorie using a sentence frame and word box. When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals

<u>Planning and Carrying out Controlled Investigations</u> 6.PS3.4 Students begin to investigate independently, select appropriate independent variables to explore a dependent variable and recognize the value of failure and revision in the experimental process. *6.ETS1.2 Students can design tests which determine the effectiveness of a device under varying conditions. **Suggested Crosscutting Concept(s)** <u>Energy and Matter</u> 6.PS3.1 Students give general descriptions of different forms and mechanisms for energy storage within a system. <u>Systems and System Models</u> 6.PS3.4 Students develop models for systems which include both visible and invisible inputs and outputs for that system. <u>Structure and Function</u> *6.ETS1.2 Students design systems, selecting materials for their relevant properties.		Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Use relationship verbs such as contain, consist of. as, then. When I changed, then happened. The more/less, then. Provide compare/contrast sentence stems: This is the same as, because. This is different than, because. All these are, because., and all have/are. To support students with the scientific explanation: <u>Question Starters</u> What's the connection between….? What link do you see between… Why do you think…? What is our evidence that…. Do we have enough evidence to make that claim? But what about this other evidence that shows…? But does your claim account for…(evidence) <u>Response Starters</u> I agree with you because of (evidence or reasoning)

		I don’t agree with your claim because of (evidence or reasoning) This evidence shows that… Your explanation makes me think about …..