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

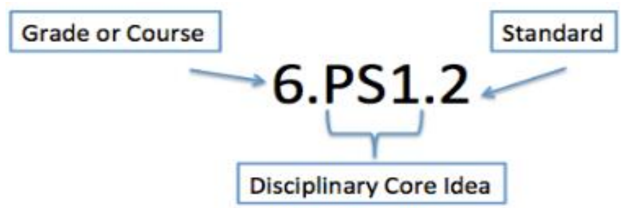
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain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

[Quarter 1 Curriculum Map Survey]

8th Grade Quarter 1 Curriculum Map					
Unit 1 Motion and Forces	Unit 2 Electricity and Magnetism	Unit 3 Waves	Unit 4 Our Universe	Unit 5 Restless Earth	Unit 6 Change Over Time
4 weeks	5 weeks	4 weeks	5 weeks	9 weeks	9 weeks
Quarter 1		Quarter 2		Quarter 3	Quarter 4

UNIT 1: Motion and Forces (4 weeks)			
Overarching Question(s)			
How can one predict an object's continued motion, changes in motion, or stability?			
Unit 1, Lesson 1	**Lesson Length**	**Essential Question**	**Vocabulary**
Motion and Speed	1 week	How are distance, time, and speed related?	motion, speed, position, vector, reference point, velocity
Standards and Related Background Information		**Instructional Focus**	**Instructional Materials**
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.3 Create a demonstration of an object in motion and describe the position, force, and direction of the object. 8.PS2.4 Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.		**Learning Outcomes** • Describe position, reference point, and motion. • Identify common distance units. • Define speed. • Differentiate between speed and average speed. • Calculate average speed. • Graph distance versus time. • Analyze the relationship between speed and line steepness on a graph. • Describe vector and velocity.	**Curricular Materials** HMH Tennessee Science TE, pp. 10-24 Engage and Explore • Engage Your Brain #s 1 and 2, SE p. 5 • Active Reading #s 3 and 4, SE p. 5 Explain Motion • Active Reading #5, SE p. 6 • Reference Points Activity, TE p. 12 • Visualize It! #6, SE p. 7 • Visualize It! #7, SE p. 7

Explanation(s) 8.PS2.3 Position, velocity (motion), acceleration (motion) and force are all examples of vector quantities. Vectors must include both a size/quantity and a direction (e.g. forward, backward, up, down). This standard introduces students to different conventions for representing these vector quantities. Representations of position and motion can be carried out using motion maps or simple graphs of position vs time and velocity vs time. Students should be able to perform qualitative comparisons from multiple representations. Forces can be represented using free-body diagrams. (See 8.PS2.3) (Performing calculations from graphs, such as determining velocity from a position time graph, is beyond the scope of this standard.) 8.PS2.4 This standard is an introduction to Newton's Second Law. Correctly stated, this law explains that acceleration is proportional to the sum of the forces acting an object and inversely proportional to the mass of an object. More simply stated, it is harder to change the motion of more massive objects. Free-body diagrams are an excellent tool for students to use to quantitatively	• Differentiate between speed and velocity. **Phenomenon**  Click on the picture to view Usain Bolt in action. How can we measure his speed?	• Investigate Changing Positions Quick Lab, TE p. 13 (SEP: Constructing Explanations and Designing Solutions) Speed • Visualize It! #8, SE p. 8 • Active Reading #9, SE p. 9 • Think Outside the Book #10, SE p. 9 • Investigate Average Speed S.T.E.M. Lab, TE p. 13 (SEP: Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying out Controlled Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions) Distance-Time Graphs • Zebra Speed Daily Demo, TE p. 13 • Active Reading #11, SE p. 10 • Do the Math #12, SE p. 11 • Visualize It! #13, SE p. 13 • Active Reading #14, SE p. 13 • Visualize It! #15, SE p. 14 • Do the Math #16, SE p. 14 Velocity • Venn Diagram #17, SE p. 15 • Neighborhood Drive Take It Home, TE p. 12 Extend Reinforce and Review

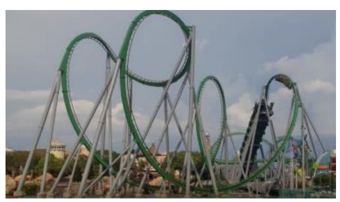
represent multiple forces acting on an object. Students can use the free body diagrams to determine total amounts of force acting parallel or perpendicular to the direction of motion of an object. Students should be able to calculate acceleration given a set of forces and the mass of an object. (Objects on inclined planes are beyond the scope of this standard. Forces should act in either the parallel or perpendicular direction, and not at intermediate angles. Forces should cancel such that net forces are either parallel or perpendicular and not at intermediate angles.) **Misconception(s)** Explain that velocity is often used to mean speed, but in science velocity is more than speed. It includes both speed and direction. **Suggested Science and Engineering Practice(s)** Analyzing and interpreting data 8.PS2.3 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. Asking questions (for science) and defining problems (for engineering) 8.PS2.4		• Speed and Motion Game Activity, TE p. 16 • Visual Summary, SE p. 16 Going Further • Physical Education Connection, TE p. 16 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 17 Summative Assessment • A Need for Speed Alternative Assessment, TE p. 17 • Lesson Quiz **Additional Resources** Billiards Video

Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **Suggested Crosscutting Concept(s)** Systems and System Models 8.PS2.3 Students make and evaluate derived/proportional measurements. Cause and Effect 8.PS2.4 Students use cause and effect relationships to make predictions.		

<table>
<tr><th colspan="4">UNIT 1: Motion and Forces (4 weeks)</th></tr>
<tr><th colspan="4">Overarching Question(s)</th></tr>
<tr><td colspan="4">How can one predict an object’s continued motion, changes in motion, or stability?</td></tr>
<tr><th>Unit 1, Lesson 2</th><th>Lesson Length</th><th>Essential Question</th><th>Vocabulary</th></tr>
<tr><td>Acceleration</td><td>1 week</td><td>How does motion change?</td><td>acceleration, centripetal acceleration</td></tr>
<tr><th colspan="2">Standards and Related Background Information</th><th>Instructional Focus</th><th>Instructional Materials</th></tr>
<tr><td colspan="2">DCI(s)
8.PS2: Motion and Stability: Forces and Interactions

Standard(s)
8.PS2.3 Create a demonstration of an object in motion and describe the position, force, and direction of the object.
8.PS2.4 Plan and conduct an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.

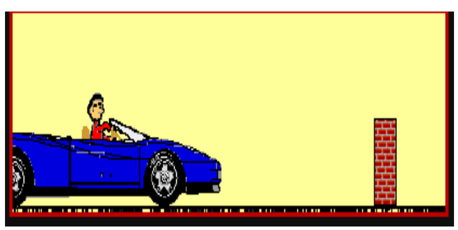
Explanation(s)
<u>8.PS2.3</u> Position, velocity (motion), acceleration (motion) and force are all examples of vector quantities. Vectors must include both a size/quantity and a direction (e.g. forward, backward, up, down). This standard introduces students to different conventions for representing</td><td>Learning Outcomes
• Describe acceleration.
• Identify common acceleration units.
• Calculate average acceleration.
• Recognize that acceleration is a change in speed, direction, or both.
• Predict the outcome of velocity and acceleration being in the same direction, and in opposite directions.

Phenomenon

Click on the picture to view the roller coaster in motion. While most people like to think that the speed of a roller coaster is what makes it fun, the real reason is acceleration. Acceleration is the change in velocity an object has. Acceleration means to speed up and</td><td>Curricular Materials
HMH Tennessee Science TE, pp. 28-39
<u>Engage and Explore</u>
• Engage Your Brain #s 1 and 2, SE p. 21
• Active Reading #s 3 and 4, SE p. 21
<u>Explain</u>
Acceleration
• Active Reading #5, SE p. 22
• Toy Car Acceleration Daily Demo, TE p. 31
• Active Reading #6, SE p. 23
• Visualize It! #7, SE p. 23
• Visualize it! #8, SE p. 23
• Investigate Acceleration S.T.E.M. Lab, TE p. 31 (SEP: Planning and Carrying out Controlled Investigations, Analyzing and Interpreting Data, Constructing Explanations and Designing Solutions)
Acceleration as a Vector
• Active Reading #9, SE p. 24</td></tr>
</table>

these vector quantities. Representations of position and motion can be carried out using motion maps or simple graphs of position vs time and velocity vs time. Students should be able to perform qualitative comparisons from multiple representations. Forces can be represented using free-body diagrams. (See 8.PS2.3) (Performing calculations from graphs, such as determining velocity from a position time graph, is beyond the scope of this standard.) 8.PS2.4 This standard is an introduction to Newton's Second Law. Correctly stated, this law explains that acceleration is proportional to the sum of the forces acting an object and inversely proportional to the mass of an object. More simply stated, it is harder to change the motion of more massive objects. Free-body diagrams are an excellent tool for students to use to quantitatively represent multiple forces acting on an object. Students can use the free body diagrams to determine total amounts of force acting parallel or perpendicular to the direction of motion of an object. Students should be able to calculate acceleration given a set of forces and the mass of an object. (Objects on inclined planes are beyond the scope of this standard. Forces should act in either the parallel or perpendicular direction, and	deceleration means to slow down. Acceleration allows the ride to be more fun because the speed becomes scarier when it comes after a slower velocity. If you go at one constant speed, it may be exciting at first, but not after some time. When the car starts to go uphill or slow down, deceleration starts to take place since the velocity is decreasing by gravity or friction.	• Inquiry #10, SE p. 25 • Do the Math #11, SE p. 25 • Roller Coaster Cartoons Activity, TE p. 30 Extend Reinforce and Review • Acceleration Game Activity, TE p. 34 • Venn Diagram Graphic Organizer, TE p. 34 • Visual Summary, SE p. 26 Going Further • Health Connection, TE p. 34 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 27 Summative Assessment • Types of Acceleration Alternative Assessment, TE p. 35 • Lesson Quiz **Additional Resources** • Acceleration Simulator • Bumper Car cK-12 Simulation • Elevator cK-12 Simulation

not at intermediate angles. Forces should cancel such that net forces are either parallel or perpendicular and not at intermediate angles.) **Misconception(s)** Students often think of acceleration as an object speeding up. They may not realize that if an object slows down it is accelerating, too-that is, it has negative acceleration. **Suggested Science and Engineering Practice(s)** <u>Analyzing and interpreting data</u> 8.PS2.3 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. <u>Asking questions (for science) and defining problems (for engineering)</u> 8.PS2.4 Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **Suggested Crosscutting Concept(s)** <u>Systems and System Models</u> 8.PS2.3		

Students make and evaluate derived/proportional measurements. <u>Cause and Effect</u> 8.PS2.4 Students use cause and effect relationships to make predictions.		

UNIT 1: Motion and Forces (4 weeks)				
Overarching Question(s)				
How can one predict an object's continued motion, changes in motion, or stability?				
Unit 1, Lesson 3	**Lesson Length**	**Essential Question**		**Vocabulary**
Forces	2 weeks	How do forces affect motion?		force, net force, inertia
Standards and Related Background Information		**Instructional Focus**		**Instructional Materials**
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.3 Create a demonstration of an object in motion and describe the position, force, and direction of the object. 8.PS2.4 Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. 8.PS2.5 Evaluate and interpret that for every force exerted on an object there is an equal force exerted in the opposite direction.		**Learning Outcomes** • Differentiate between contact forces and forces that act at a distance. • Compare the effect of balanced and unbalanced forces on an object. • Explain Newton's first law using the concept of inertia. • Describe the relationship among force, mass, and acceleration (Newton's second law) • Calculate force, mass, or acceleration given two of three variables. • Explain how forces act in pairs (Newton's third law) **Phenomenon**  Why do people stay in motion when a car stops? Click on the picture to display what happens when seatbelts are not used. The animation can		**Curricular Materials** HMH Tennessee Science, pp. 40-54 <u>Engage and Explore</u> • Engage Your Brain #s 1 and 2, SE p. 29 • Active Reading #s3 and 4, SE p. 29 <u>Explain</u> Introduction to Force • Noncontact Forces Activity, TE p. 42 • Active Reading #5, SE p. 30 • Visualize It! #6, SE p. 30 • Visualize It! #7, SE p. 31 Net Force • Active Reading #8, SE p. 32 • Combining Forces Discussion, TE p. 42 • Visualize It! #9, SE p. 32 • Visualize It! #10, SE p. 33 • Balloon Action Activity, TE p. 42

Explanation(s) 8.PS2.3 Position, velocity (motion), acceleration (motion) and force are all examples of vector quantities. Vectors must include both a size/quantity and a direction (e.g. forward, backward, up, down). This standard introduces students to different conventions for representing these vector quantities. Representations of position and motion can be carried out using motion maps or simple graphs of position vs time and velocity vs time. Students should be able to perform qualitative comparisons from multiple representations. Forces can be represented using free-body diagrams. (See 8.PS2.3) (Performing calculations from graphs, such as determining velocity from a position time graph, is beyond the scope of this standard.) 8.PS2.4 This standard is an introduction to Newton's Second Law. Correctly stated, this law explains that acceleration is proportional to the sum of the forces acting an object and inversely	be used to demonstrate Newton's Laws of Motion.	• Net Force Quick Lab, TE p. 43 (SEP: Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) • Sliding Downhill Virtual Lab, TE p. 43 Newton's Laws • Active Reading #11, SE p. 34 • Visualize It! #12, SE p. 34 • Think Outside the Book #13, SE p. 35 • Visualize It! #14, TE p. 35 • First Law of Skateboarding Quick Lab, TE p. 43 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) • Active Reading #15, SE p. 36 • Do the Math #16, SE p. 36 (SEP: Using Mathematics and Computational Thinking) • Visualize It! #20, SE p. 38 • Visualize It! #21, SE p. 39 • Visualize It! #22, SE p. 39 • Action vs. Reaction Daily Demo, TE p. 43 • Newton's Laws of Motion S.T.E.M. Lab, TE p. 43 (SEP: Developing and

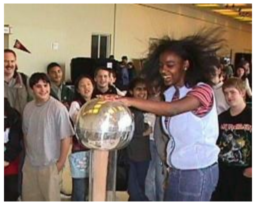
proportional to the mass of an object. More simply stated, it is harder to change the motion of more massive objects. Free-body diagrams are an excellent tool for students to use to quantitatively represent multiple forces acting on an object. Students can use the free body diagrams to determine total amounts of force acting parallel or perpendicular to the direction of motion of an object. Students should be able to calculate acceleration given a set of forces and the mass of an object. (Objects on inclined planes are beyond the scope of this standard. Forces should act in either the parallel or perpendicular direction, and not at intermediate angles. Forces should cancel such that net forces are either parallel or perpendicular and not at intermediate angles.) 8.PS2.5 This standard provides students with exposure to Newton's Third Law. This standard provides a complement to 8.PS2.4. When diagramming forces using free-body diagrams, it should be noted that a pair of third law forces will not be found on the same diagram. It will always		Using Models, Planning and Carrying Out Controlled Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions) Extend Reinforce and Review • Mind Map Graphic Organizer, TE p. 46 • Visual Summary, SE p. 40 Going Further • Environmental Science, TE p. 46 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 41 Summative Assessment • Forces, Motions, and Newton's Laws Alternative Assessment, TE p. 47 • Lesson Quiz • Unit 1 Summary, SE p. 42 • Unit 1 Review, SE p. 43-46 **Additional Resources** • Science of NFL Football: Newton's Third Law of Motion

require two diagrams to show a third law pair. For example, when a person stands of a bathroom scale, they exert a normal force acting downward on the scale which results in an equal, yet opposite normal force being exerted upwards by the scale. One force is exerted by the person, the other by the scale. Even when a force results in motion for only one object, there is an equal and opposite force resulting from the first force. Jumping is accomplished because a person pushes down on the ground, and the ground pushes back up with an equal and opposite force accelerating the person upwards. **Misconception(s)** Students may not understand that an object at rest can exert a force on another object. Emphasize that forces cause a change in motion, but it is not necessary for an object to be moving for it to exert a force on another object. **Suggested Science and Engineering Practice(s)** Analyzing and interpreting data 8.PS2.3		• Science of NFL Football: Newton's First Law of Motion • Science of NFL Football: Newton's Second Law of Motion • Football: Mass, Momentum, and Collision Article • Newton's First Law: Inertia STUDY JAMS! Video • Newton's Second Law: Acceleration STUDY JAMS! Video • Newton's Third Law: Action & Reaction STUDY JAMS! Video • Force & Motion STUDY JAMS! Video • Forces and Motion PhET Interactive Simulation • Lift Chair Challenge

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. Asking questions (for science) and defining problems (for engineering) 8.PS2.4 Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. Constructing explanations and designing solutions 8.PS2.5 Students form explanations using source (including student developed investigations) which show comprehension of parsimony, utilize quantitative and qualitative models to make predictions, and can support or cause revisions of a particular conclusion. **Suggested Crosscutting Concept(s)** Systems and System Models 8.PS2.3		

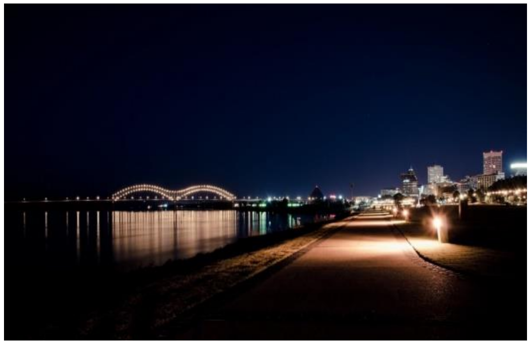
Students make and evaluate derived/proportional measurements. Cause and Effect 8.PS2.4, 8.PS2.5 Students use cause and effect relationships to make predictions.		

UNIT 2: Electricity and Magnetism [5 weeks]				
Overarching Question(s)				
What underlying forces explain the variety of interactions observed?				
Unit 2, Lesson 1	**Lesson Length**	**Essential Question**		**Vocabulary**
Electric Charge and Static Electricity	1 week	What makes something electrically charged?		electrical charge, static electricity, electrical conductor, electrical insulator, semiconductor
Standards and Related Background Information		**Instructional Focus**		**Instructional Materials**
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.2 Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. **Explanation(s)** <u>8.PS2.2</u> Students have already been exposed to the idea of gravity in fifth grade and have discussed the mechanisms for storing potential energy in magnetic, gravitational, and electric fields. However, this is the first time where students explore that forces can act on without the objects making contact. These non-contact forces should be incorporated in discussions of Newton's Laws in other standards. Once a student is competent in		**Learning Outcomes** • Describe electric charge as a fundamental property of matter. • Distinguish between the two types of electric charge. • Describe the ways in which objects can become electrically charged. • Describe the conservation of electric charge. • Describe the nature of electric force between two charged objects. • Distinguish between an electrical conductor and an electrical insulator. • Describe what makes semiconductors so important to today's electronics.		**Curricular Materials** HMH Tennessee Science TE, pp. 70-82 <u>Engage and Explore</u> • Engage Your Brain #s 1and 2, SE p. 51 • Active Reading #s 3 and 4, SE p. 51 <u>Explain</u> Electric Charge • Observing Static Electricity Activity, TE p. 72 • Active Reading #5, SE p. 52 • Visualize It! #6, SE p. 52 Electric Force • Active Reading #7, SE p. 53 • Tape Interactions Activity, TE p. 72 • Visualize It! #8, SE p. 53 How Can Static Electric Charges Affect Each Other? Virtual Lab, TE p. 73 Electric Charge • Active Reading #9, SE p. 54 • Water Magic Daily Demo, TE p. 73

diagramming motion maps, and grounded in Newton's Second Law, a foundation exists to infer that non-contact forces must exist in order for objects in freefall to accelerate. **Suggested Science and Engineering Practice(s)** Constructing explanations and designing solutions Students form explanations using source (including student developed investigations) which show comprehension of parsimony, utilize quantitative and qualitative models to make predictions, and can support or cause revisions of a particular conclusion. **Suggested Crosscutting Concept(s)** Systems and System Models Students develop models for systems which include both visible and invisible inputs and outputs for that system.	**Phenomenon**  The Van de Graaff generator in the picture works by static electricity. The electrons repel each other, so they try to get as far away from each other as possible. We see this effect when the volunteer's hair moves as far away from the body as it can!	• Active Reading #10, SE p. 55 • Think Outside the Book #11, SE p. 55 • Making a Static Detector Quick Lab, TE p. 73 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) Conductors, Insulators, and Semiconductors • Visualize It! #12, SE p. 56 • Summarize #13, SE p. 57 Electric Charge • Active Reading #14, SE p. 57 Extend Reinforce and Review • Electric Charge Carousel Activity, TE p. 76 • Concept Map Graphic Organizer, TE p. 76 • Visual Summary, SE p. 58 Going Further • Earth Science Connection, TE p. 72 • Mathematics Connection, TE p. 72 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 59 • Reteach, TE p. 77 Summative Assessment • Charge It! Alternative Assessment, TE p. 77 • Lesson Quiz

		Additional Resources • Floating Static Bands • Balloons and Static Electricity PhET Interactive Simulation • 8.PS2.2 Student Activity and Teacher Guide • Levitation Engineers

UNIT 2: Electricity and Magnetism [5 weeks]			
Overarching Question(s)			
What underlying forces explain the variety of interactions observed?			
Unit 2, Lesson 2	**Lesson Length**	**Essential Question**	**Vocabulary**
Electric Current	1 week	What flows through electric wire?	electric current, voltage, resistance
Standards and Related Background Information		**Instructional Focus**	**Instructional Materials**
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.2 Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. **Explanation(s)** <u>8.PS2.2</u> Students have already been exposed to the idea of gravity in fifth grade and have discussed the mechanisms for storing potential energy in magnetic, gravitational, and electric fields. However, this is the first time where students explore that forces can act on without the objects making contact. These non-contact forces should be incorporated in discussions of Newton's Laws in other standards. Once a student is competent in diagramming motion maps, and grounded in Newton's Second Law, a foundation exists to infer		**Learning Outcomes** • Describe electric current. • Compare direct to alternating current, and describe some everyday devices that use each. • Describe voltage and its relationship to electric current. • Describe resistance and its relationship to electric current. • Describe factors that can affect resistance.	**Curricular Materials** HMH Tennessee Science TE, pp. 84-95 <u>Engage and Explore</u> • Engage Your Brain #s1 and 2, SE p. 92 • Active Reading #s 3 and 4, SE p. 92 <u>Explain</u> Current • Active Reading #5, SE p. 62 • Visualize It! #6, SE p. 62 • Active Reading #7, SE p. 62 • Investigate Electric Current Quick Lab, TE p. 87 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) Voltage • Visualize It! #8, SE p. 64 Resistance • Think Outside the Book #9, SE p. 64

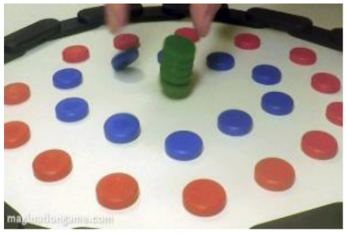
that non-contact forces must exist in order for objects in freefall to accelerate. **Misconception(s)** Static electricity and electric current both involve electric charge but are two different phenomena. Static electricity is the buildup of electric charge on the surface of an object. In contrast, electric current is the rate of flow of electric charges along a conductor. Electric current is normally controlled, while static electricity may rapidly change. **Suggested Science and Engineering Practice(s)** Constructing explanations and designing solutions Students form explanations using source (including student developed investigations) which show comprehension of parsimony, utilize quantitative and qualitative models to make predictions, and can support or cause revisions of a particular conclusion. **Suggested Crosscutting Concept(s)** Systems and System Models Students develop models for systems which include both visible and invisible inputs and outputs for that system.	**Phenomenon**  Electric current sent over wires from power plants throughout Memphis supply our city with energy for lights and other uses.	• Visualize It! #10, SE p. 65 Extend Reinforce and Review • Cluster Diagram Graphic Organizer, TE p. 90 • Visual Summary, SE p. 66 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 67 • Reteach, TE p. 91 Summative Assessment • Electric Currents Alternate Assessment, TE p. 91 • Lesson Quiz **Additional Resources** • Levitation Engineers • 8.PS2.2 Student Activity and Teacher Guide

UNIT 2: Electricity and Magnetism [5 weeks]			
Overarching Question(s)			
What underlying forces explain the variety of interactions observed?			
Unit 2, Lesson 3	**Lesson Length**	**Essential Question**	**Vocabulary**
Electric Circuits	3 days	How do electric circuits work?	electrical circuit, parallel circuit, series circuit
Standards and Related Background Information		**Instructional Focus**	**Instructional Materials**
DCI(s) **Standard(s)** **Explanation(s)** **Misconception(s)** **Suggested Science and Engineering Practice(s)** **Suggested Crosscutting Concept(s)** Lesson 6 is designed to provide background knowledge for students before continued learning of standards within Disciplinary Core Idea, PS2: Motion and Stability: Forces and Interactions.		**Learning Outcomes** • Describe the parts of an electric circuit. • Distinguish between open and closed circuits. • Distinguish between a series circuit and a parallel circuit • Describe why you must use precautions when using electrical appliances. • Describe some devices that make using electricity safer. • Describe safety measures that protect people and buildings during a lightning storm.	**Curricular Materials** HMH Tennessee Science TE, pp. 96-109 Engage and Explore • Will It Light? Daily Demo, TE p. 98 • Engage Your Brain #s 1 and 2, SE p. 69 • Active Reading #s 3 and 4, SE p. 69 Explain Electric Circuits • Active Reading #5, SE p. 70 • Think Outside the Book #6, SE p. 70 • Visualize It! #7, SE p. 71 • Active Reading #8, SE p. 72 • Active Reading #9, SE p. 73 • Visualize It! #10, SE p. 73 • Active Reading #11, SE p. 74 • Visualize It! #12, SE p. 74 • Compare #13, SE p. 75 • Compare Parallel and Series Circuits Quick Lab, TE p. 99 (SEP: Developing and Using Models,

	Phenomenon  Click on the light switch to view the video. Switches open and close electrical circuits, allowing power to flow through lights and appliances.	Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) • How Can You Change Current in an Electric Circuit? Virtual Lab, TE p. 99 Electrical Safety • Active Reading #14, SE p. 76 • Active Reading #15, SE p. 77 • Infer #16, SE p. 77 <u>Extend</u> Reinforce and Review • Visual Summary, SE p. 78 <u>Evaluate</u> Formative Assessment • Throughout TE • Lesson Review, SE p. 79 • Reteach, TE p. 103 Summative Assessment • Electric Circuits Alternative Assessment, TE p. 103 • Lesson Quiz **Additional Resources** • Circuit Construction Kit: DC PhET Simulator • Electric Circuits cK-12 Article

UNIT 2: Electricity and Magnetism [5 weeks]			
Overarching Question(s)			
What underlying forces explain the variety of interactions observed?			
Unit 2, Lesson 4	**Lesson Length**	**Essential Question**	**Vocabulary**
Magnets and Magnetism	1 week	What is magnetism?	magnet, magnetic pole, magnetic force, magnetic field

Standards and Related Background Information	**Instructional Focus**	**Instructional Materials**
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.1 Design and conduct investigations depicting the relationship between magnetism and electricity in electromagnets, generators, and electrical motors, emphasizing the factors that increase or diminish the electric current and the magnetic field strength. 8.PS2.2 Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. **Explanation(s)** <u>8.PS2.1</u> Students should develop a basic understanding that electric currents produce magnetic fields as well as understanding a	**Learning Outcomes** • Describe the properties of magnets. • Explain what magnetic poles and magnetic fields are. • Describe how magnets attract and repel. • Explain what causes magnetic fields and magnetism. • Explain why some materials are magnetic and some are not. • Explain how domains can cause materials to be magnetic. • Distinguish between different types of magnets based on their magnetic properties. • Explain how Earth acts as a magnet. • Explain how Earth's geographic and magnetic poles differ.	**Curricular Materials** HMH Tennessee Science, TE pp. 114-126 <u>Engage and Explore</u> • Magnets at Work Activity, TE p. 116 • Engage Your Brain #s 1 and 2, SE p. 85 • Active Reading #s 3 and 4, SE p. 85 <u>Explain</u> Properties of Magnets • Infer #5, SE p. 86 • State #6, SE p. 86 • Magnet Power Probing Question, TE p.116 • Visualize It! #7, SE p. 87 • Visualize It! #8, SE p. 87 • Making Magnets Quick Lab, TE p. 117 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) Properties of Magnetic Fields

conductor moved through a magnetic field will develop an electric current. The phenomena of induced currents can be observed using a galvanometer attached to the two ends of an unplugged extension cord if the cord is moved in a jump-rope type manner. The reciprocal phenomena of magnetic fields produced by electric currents can be observed with a compass placed around a current carrying wire. Once the reciprocal nature of electric and magnetic fields have been investigated, students can apply their knowledge through investigations into motors, generators and solenoids and the design factors that influence the functioning of these devices. <u>8.PS2.2</u> Students have already been exposed to the idea of gravity in fifth grade and have discussed the mechanisms for storing potential energy in magnetic, gravitational, and electric fields. However, this is the first time where students explore that forces can act on without the objects making contact. These non-contact forces should be incorporated in discussions of Newton's Laws in other standards. Once a student is competent in diagramming motion maps, and grounded in Newton's Second Law, a foundation exists to infer that non-contact forces must exist in order for objects in freefall to accelerate.	**Phenomenon**  Click on the picture to demonstrate how magnets interact with one another. Arranged in layered rings, the stationary magnets are at rest until interrupted by another magnet dropped into the center of the ring. When the dropped magnet comes in contact with the magnet at the center of the ring, the magnets link resulting in a broader magnetic field being created. This in effect causes the other magnets at rest to then be inside the newly formed magnetic field and linking to the magnets at the center of the ring.	• Visualize It! #9 • Seeing Magnetic Fields Daily Demo, TE p. 117 • Studying Magnetism Quick Lab, TE p. 117 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) Types of Magnets • Magnetic Attraction Activity, TE p. 116 • Think Outside the Book #10, SE p. 89 Earth's Magnetic Field • Active Reading #11, SE p. 90 • Infer #12, SE p. 90 • Visualize It! #13, SE p. 91 <u>Extend</u> Reinforce and Review • Cluster Diagram Graphic Organizer, TE p. 120 • Visual Summary, SE p. 98 Going Further • Social Studies Connection, TE p. 120 • Biology Connection, TE p. 120 <u>Evaluate</u> Formative Assessment • Throughout TE • Lesson Review, SE p. 93 • Reteach, TE p. 121 Summative Assessment

Suggested Science and Engineering Practice(s) Planning and Carrying Out Controlled Investigations 8.PS2.1 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. Constructing Explanations and Designing Solutions 8.PS2.2 Students form explanations using source (including student developed investigations) which show comprehension of parsimony, utilize quantitative and qualitative models to make predictions, and can support or cause revisions of a particular conclusion. **Suggested Crosscutting Concept(s)** Structure and Function 8.PS2.1 Students design systems, selecting materials for their relevant properties. Systems and System Models 8.PS2.2 Students develop models for systems which include both visible and invisible inputs and outputs for that system.		• Magnetic Madness Alternative Assessment, TE p. 121 • Lesson Quiz **Additional Resources** • Inspector Detector Challenge • 8.PS2.1 Student Activity and Teacher Guide • 8.PS2.2 Student Activity and Teacher Guide • Electric Train Video

UNIT 2: Electricity and Magnetism [5 weeks]			
Overarching Question(s)			
What underlying forces explain the variety of interactions observed?			
Unit 2, Lesson 5	**Lesson Length**	**Essential Question**	**Vocabulary**
Electromagnetism	2 weeks	What is electromagnetism?	electromagnetism, electric motor, electromagnetic induction, solenoid, transformer, electromagnet, electric generator

Standards and Related Background Information	Instructional Focus	Instructional Materials
DCI(s) 8.PS2: Motion and Stability: Forces and Interactions **Standard(s)** 8.PS2.1 Design and conduct investigations depicting the relationship between magnetism and electricity in electromagnets, generators, and electrical motors, emphasizing the factors that increase or diminish the electric current and the magnetic field strength. 8.PS2.2 Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. 8.ETS1.1 Develop a model to generate data for ongoing testing and modification of an electromagnet, a generator, and a motor such that an optimal design can be achieved.	**Learning Outcomes** • Describe electromagnetism. • Describe a solenoid and how it works. • Describe what an electromagnet is and how one is constructed. • Describe some ways in which electromagnets are used in everyday life. • Explain how a magnetic field can make an electric current through induction. • Explain how induction is used in generators. • Describe transformers.	**Curricular Materials** HMH Tennessee Science, TE pp. 128-149 Engage and Explore • Engage Your Brain #s 1 and 2, SE p. 95 • Active Reading #s 3 and 4, SE p. 95 • Electromagnetic Relationships Activity, TE p. 130 Explain Electromagnetism • Active Reading #5, SE p. 96 • Magnetic Fields Daily Demo, TE p. 131 Electromagnets • Active Reading #6, SE p. 97 • Building an Electromagnet Quick Lab, TE p. 131 (SEP: Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions)

Explanation(s)	Phenomenon	
8.PS2.1 Students should develop a basic understanding that electric currents produce magnetic fields as well as understanding a conductor moved through a magnetic field will develop an electric current. The phenomena of induced currents can be observed using a galvanometer attached to the two ends of an unplugged extension cord if the cord is moved in a jump-rope type manner. The reciprocal phenomena of magnetic fields produced by electric currents can be observed with a compass placed around a current carrying wire. Once the reciprocal nature of electric and magnetic fields have been investigated, students can apply their knowledge through investigations into motors, generators and solenoids and the design factors that influence the functioning of these devices. 8.PS2.2 Students have already been exposed to the idea of gravity in fifth grade and have discussed the mechanisms for storing potential energy in magnetic, gravitational, and electric fields. However, this is the first time where students explore that forces can act on without the objects making contact. These non-contact forces should be incorporated in discussions of Newton's Laws in other standards. Once a student is competent in	 Click on the picture to view how an electromagnet is used to pick up large pieces of metal. Electromagnets are devices that create a magnetic field through the application of electricity. Wrecking yards employ extremely powerful electromagnets to move heavy pieces of scrap metal or even entire cars from one place to another.	Uses of Electromagnets • Inquiry #7, SE p. 98 • Visualize It! #11, SE p. 100 • Visualize It! #12, SE p. 101 • Building a Speaker S.T.E.M. Lab, TE p. 131 Induction • Visualize It! #s 13-14, SE p. 102 • Active Reading #15, SE p. 103 • Do the Math #16, SE p. 103 • Think Outside the Book #17, SE p. 104 • Active Reading #18, SE p. 104 • Diagram #19, SE p. 105 • Making an Electric Generator Quick Lab, TE p. 131 (Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) • Building a Speaker S.T.E.M. Lab, TE p. 131 (SEP: Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Controlled Investigations, Constructing Explanations and Designing Solutions) Extend Reinforce and Review • Mind Map Graphic Organizer, TE p. 134 • Visual Summary, SE p. 120 Going Further

diagramming motion maps, and grounded in Newton's Second Law, a foundation exists to infer that non-contact forces must exist in order for objects in freefall to accelerate. 8.ETS1.1 In 5.ESS1.1 students learned that there are different types of stars, while 7.PS1 addresses both atomic structure and the variety of elements found in the universe. This standard unifies these separate discussions. Many students struggle to grasp the idea that the mass of the universe could have emanated from a single point. This misconception illuminates a failure to grasp that all mass was once energy, and energy does not occupy space. Stars are regions in space where immense gravitation facilitates the conversion of mass back into energy via nuclear fusion. The energy released in these processes increases the thermal energy of the gaseous atoms making up the star or radiates out into space. This radiant energy (some of which is visible light) can be detected. The exact color of a star depends on its composition since each element releases only specific colors of light. Thus, a star's composition can be determined by evaluating the color of light that it radiates. Building on grade level discussions of wave properties, student should explore Doppler shift as evidence for the expansion of the universe. A model used to demonstrate Doppler		• Life Science Connection, TE p. 134 • Earth Science Connection, TE p. 134 • Why It Matters, SE p. 99 • Building an Electromagnet, SE p. 108-111 • Making an Electric Generator, SE p. 112-115 • Electric Motors, SE p. 116-119 Evaluate Formative Assessment • Throughout TE • Lesson Review, SE p. 121 • Reteach, TE p. 135 Summative Assessment • Electromagnetism Alternative Assessment, TE p. 135 • Lesson Quiz • Unit 2 Big Idea, SE p. 122 • Unit 2 Review, SE p. 123-128 **Additional Resources** • Electromagnetic Power! Lesson • Electromagnetism Lesson • The Good, the Bad and the Electromagnet

shift can be created by placing a buzzer into a tennis ball and twirling the tennis ball in a circular motion above one's head. The person twirling the ball will not hear a variation in the tone as the ball is a fixed distance from their head, but observers will experience the Doppler shift in the sound. **Suggested Science and Engineering Practice(s)** <u>Planning and Carrying Out Controlled Investigations</u> 8.PS2.1 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. <u>Constructing Explanations and Designing Solutions</u> 8.PS2.2 Students form explanations using source (including student developed investigations) which show comprehension of parsimony, utilize quantitative and qualitative models to make predictions, and can support or cause revisions of a particular conclusion. <u>Asking questions (for science) and defining problems (for engineering</u> 8.ETS1.1		

Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. **Suggested Crosscutting Concept(s)** Structure and Function 8.PS2.1 Students design systems, selecting materials for their relevant properties. Systems and System Models 8.PS2.2 Students develop models for systems which include both visible and invisible inputs and outputs for that system. Energy and Matter 8.ETS1.1 Students track energy changes through transformations in a system.		