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

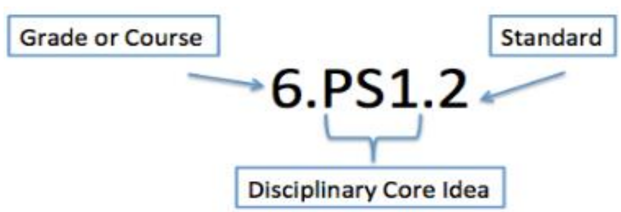
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain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

8^{th} Grade Quarter 1 Curriculum Map

Quarter 1			Quarter 2		Quarter 3	Quarter 4
Structures & Routines	**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
1 week	**4 weeks**	5 weeks	4 weeks	5 weeks	9 weeks	9 weeks

UNIT 1: Motion and Forces (4 weeks)

Overarching Question(s)

How can one explain and predict interactions between objects and within systems of objects?

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 Resources
DCI(s) 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. **Explanation(s) and Support of Standard(s) from TN Science Reference Guide** 8.PS2.3 Students should investigate a system that includes an object, the position of the object and a set of forces acting on an object. The demonstration referenced in the standard refers to a complete description of a system used to	**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. • Differentiate between speed and velocity.	**Curricular Resources** HMH Tennessee Science TE, Unit 1, Lesson 1 pp. 10-24 Engage • Engage Your Brain #s 1 and 2, SE p. 5 • Active Reading #s 3 and 4, SE p. 5 Motion • Reference Points Activity, TE p. 12 Distance-Time Graphs • Zebra Speed Daily Demo, TE p. 13 Explore Motion • Investigate Changing Positions Quick Lab, TE p. 13 Speed

investigate a number of forces acting on an object, accounting for the size and direction of the forces, as well as the mass of the object. The position of the object should be based on some frame of reference established by the student. Direction of the object refers to the direction of the motion of an object (velocity and acceleration). It is possible to describe and model both motion and position — the car was 20m beyond the intersection and traveling with a speed of 45km/hr. In examples such as the car referenced above, students should recognize that it may be more practical to reference the motion of the car with respect to the intersection. This means that the origin for their coordinate system/number line would be the origin and the object would have a present position at 20m. Students should only consider motion that occurs in a single dimension. This does not mean that systems cannot include objects moving diagonally. In such circumstances, the student should recognize that part of describing the motion of an object includes establishing a frame of reference. If the object is moving diagonally, the frame of reference should be described parallel to the direction of motion, rather than simply describing the motion relative to up, down, right, and left directions. With this relative frame of reference, forces and motion	**Suggested Phenomenon**  Click on the picture to view Usain Bolt in action. How can we measure his speed? Students can complete a See Think Wonder Template after watching the video.	• Investigate Average Speed S.T.E.M. Lab, TE p. 13 Velocity • Neighborhood Drive Take It Home, TE p. 12 <u>Explain</u> Motion • Active Reading #5, SE p. 6 • Visualize It! #6, SE p. 7 • Visualize It! #7, SE p. 7 Speed • Visualize It! #8, SE p. 8 • Active Reading #9, SE p. 9 • Think Outside the Book #10, SE p. 9 Distance-Time Graphs • 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 <u>Extend</u> Reinforce and Review • Speed and Motion Game Activity, TE p. 16 • Visual Summary, SE p. 16 Going Further • Physical Education Connection, TE p. 16

can be labeled as either parallel or perpendicular to the objects motion. **Suggested Science and Engineering Practice(s)** Developing and Using Models 8.PS2.3 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. **Suggested Crosscutting Concept(s)** Systems and System Models 8.PS2.3 Students develop models for systems which include both visible and invisible inputs and outputs for that system.		Evaluate Formative Assessment • Reteach, TE p. 17 • Throughout TE • Lesson Review, SE p. 17 Summative Assessment • A Need for Speed Alternative Assessment, TE p. 17 • Lesson Quiz **Additional Resources** • Billiards Video • Forces and Motion PhET Simulation • Slow Your Roll Exploratorium Science Snack **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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold)

		• Students will orally describe position, reference point, and motion using a word box and visuals. • Students will define speed orally using a complete sentence and a word box to support. • Students will talk with a partner to differentiate between speed and average speed. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) proportional, position, relationship, steep, net forces Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Differentiating sentences frames: When I compared ______, I noticed that... When I compared this year's data with last year's, I noticed that... The difference between... There are similarities between... Defining stems: Speed is defined by…. The definition of speed is…..

		For Labs and partner work, consider providing these stems: <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 …..

<table>
<tr><th colspan="8">8th Grade Quarter 1 Curriculum Map</th></tr>
<tr><td colspan="3">Quarter 1</td><td colspan="2">Quarter 2</td><td>Quarter 3</td><td colspan="2">Quarter 4</td></tr>
<tr><td>Structures & Routines</td><td>Unit 1 Motion and Forces</td><td>Unit 2
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<tr><td colspan="8">UNIT 1: Motion and Forces (4 weeks)</td></tr>
<tr><td colspan="8">Overarching Question(s)</td></tr>
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<tr><td colspan="2">Unit 1, Lesson 2</td><td>Lesson Length</td><td colspan="2">Essential Question</td><td colspan="3">Vocabulary</td></tr>
<tr><td colspan="2">Acceleration</td><td>1 week</td><td colspan="2">How does motion change?</td><td colspan="3">acceleration, centripetal acceleration</td></tr>
<tr><td colspan="3">Standards and Related Background Information</td><td colspan="2">Instructional Focus</td><td colspan="3">Instructional Resources</td></tr>
<tr><td colspan="3">DCI(s)
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.

Explanation(s) and Support of Standard(s) from TN Science Reference Guide
8.PS2.3 Students should investigate a system that includes an object, the position of the object and a set of forces acting on an object. The demonstration referenced in the standard refers to a complete description of a system used to investigate a number of forces acting on an object,</td><td colspan="2">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.</td><td colspan="3">Curricular Resources
HMH Tennessee Science TE, Unit 1, Lesson 2 pp. 28-39
Engage
• Engage Your Brain #s 1 and 2, SE p. 21
• Active Reading #s 3 and 4, SE p. 21
Acceleration
• Toy Car Acceleration Daily Demo, TE p. 31
Explore
Acceleration
• Investigate Acceleration S.T.E.M. Lab, TE p. 31
Explain
Acceleration
• Active Reading #5, SE p. 22
• Active Reading #6, SE p. 23
• Visualize It! #7, SE p. 23</td></tr>
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accounting for the size and direction of the forces, as well as the mass of the object. The position of the object should be based on some frame of reference established by the student. Direction of the object refers to the direction of the motion of an object (velocity and acceleration). It is possible to describe and model both motion and position — the car was 20m beyond the intersection and traveling with a speed of 45km/hr. In examples such as the car referenced above, students should recognize that it may be more practical to reference the motion of the car with respect to the intersection. This means that the origin for their coordinate system/number line would be the origin and the object would have a present position at 20m. Students should only consider motion that occurs in a single dimension. This does not mean that systems cannot include objects moving diagonally. In such circumstances, the student should recognize that part of describing the motion of an object includes establishing a frame of reference. If the object is moving diagonally, the frame of reference should be described parallel to the direction of motion, rather than simply describing the motion relative to up, down, right, and left directions. With this relative frame of reference, forces and motion can be labeled as either parallel or perpendicular to the objects motion.	**Suggested 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 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. Students can complete a See Think Wonder Template after watching the video.	• Visualize it! #8, SE p. 23 Acceleration as a Vector • Active Reading #9, SE p. 24 • Inquiry #10, SE p. 25 • Do the Math #11, SE p. 25 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 • Reteach, TE p. 35 • 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

Suggested Science and Engineering Practice(s) Developing and Using Models 8.PS2.3 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. **Suggested Crosscutting Concept(s)** Systems and System Models 8.PS2.3 Students develop models for systems which include both visible and invisible inputs and outputs for that system.		**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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold) • Students will describe acceleration in writing using predetermined vocabulary. • With a partner, students will identify common acceleration units. • Students will demonstrate that they recognize that acceleration is a change in speed, direction, or both by explaining in writing the change that occurred. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) interactions, acceleration, speeding up, force, acting on

		Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Sentence Stems: The object accelerated because…… Acceleration is… Acceleration is not…. I determined how much the object accelerated by…. For Labs and partner work, consider providing these stems: <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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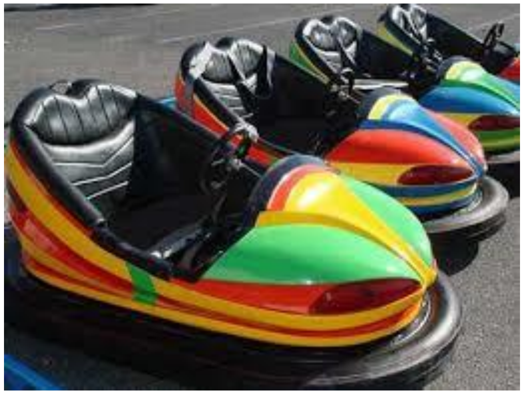
UNIT 1: Motion and Forces (4 weeks)

Overarching Question(s)

How can one explain and predict interactions between objects and within systems of objects?

Unit 1, Lesson 3	Lesson Length	Essential Question	Vocabulary
Forces	1.5 weeks	How do forces affect motion?	force, net force, inertia

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) 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)	**Curricular Resources** HMH Tennessee Science, Unit 1, Lesson 3 pp. 40-54 Engage • Engage Your Brain #s 1 and 2, SE p. 29 • Active Reading #s3 and 4, SE p. 29 Introduction to Force • Noncontact Forces Activity, TE p. 42 Explore Net Force • Balloon Action Activity, TE p. 42 • Net Force Quick Lab, TE p. 43 • Sliding Downhill Virtual Lab, TE p. 43 Newton's Laws • First Law of Skateboarding Quick Lab, TE p. 43

Explanation(s) and Support of Standard(s) [from TN Science Reference Guide]	**Suggested Phenomenon**	Explain
8.PS2.3 Students should investigate a system that includes an object, the position of the object and a set of forces acting on an object. The demonstration referenced in the standard refers to a complete description of a system used to investigate a number of forces acting on an object, accounting for the size and direction of the forces, as well as the mass of the object. The position of the object should be based on some frame of reference established by the student. Direction of the object refers to the direction of the motion of an object (velocity and acceleration). It is possible to describe and model both motion and position — the car was 20m beyond the intersection and traveling with a speed of 45km/hr. In examples such as the car referenced above, students should recognize that it may be more practical to reference the motion of the car with respect to the intersection. This means that the origin for their coordinate system/number line would be the origin and the object would have a present position at 20m. Students should only consider motion that occurs in a single dimension. This does not mean that systems cannot include objects moving diagonally. In such circumstances, the student should recognize that part of describing the motion of an	 All three of Newton's laws of motion are in action during the bumper car game. Click on the picture above to see a video of riders engaged in a game. Descriptions of Newton's Laws of Motion are listed below. Students can complete a See Think Wonder Template after watching the video. Newton's 1st Law of Motion – Every object in motion continues in motion and every object at rest continues to be at rest unless an outside force acts upon it. This is called inertia. When you are riding in a bumper car and end up in a collision with another bumper car, you feel a jolt. Your body's inertia causes your body to keep moving, even though your bumper car has now suddenly stopped. The security bar or safety harness provides the force that jolts your body to a stop.	Introduction to Force • 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 • Visualize It! #9, SE p. 32 • Visualize It! #10, SE p. 33 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 • Active Reading #15, SE p. 36 • Do the Math #16, SE p. 36 • 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 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

object includes establishing a frame of reference. If the object is moving diagonally, the frame of reference should be described parallel to the direction of motion, rather than simply describing the motion relative to up, down, right, and left directions. With this relative frame of reference, forces and motion can be labeled as either parallel or perpendicular to the objects motion. 8.PS2.4 This standard is an introduction to Newton's Second Law. This law explains 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. Student investigations should include systems with both balanced and unbalanced forces with the objective of gathering evidence that the change in the motion of an object is a result of the sum of the forces on the object and the mass of the object. Conceptually, it is very important that students recognize that the net force is always a sum. If forces act in opposite directions, students should recognize that forces combined by adding a positive value with a negative value, and never	Newton's 1st law of motion is the reason why it is so important to wear seat belts when riding in cars! Newton's 2nd Law of Motion – The greater the mass of an object, the greater the force needed to change the object's motion. When riding in bumper cars, you may have noticed that people who weigh less tend to get bumped around more than people who weigh more. That's because it takes a greater force to move the cars with heavier (more mass) riders than it does to move the cars with lighter (less mass) riders. Newton's 3rd Law of Motion – For every action, there is an equal and opposite reaction. If two bumper cars traveling at the same speed and carrying the same amount of weight run into each other, they will bounce off and move an equal distance away from each other. However, if there is a difference in the amount of weight being carried in the two cars, the car with less weight will get bumped farther away from the point of impact than the car carrying more weight.	• Reteach, TE p. 47 • 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 • 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 • Newton's Second Law Lesson

through subtraction of a positive value from another positive value. The investigation should include the collection of data that describes the motion of the object (velocity) or changes to the motion of the object (acceleration), the total force acting on the object, and the mass of the object. Students should be involved in decisions about how to measure the motion of the object, the forces acting on the object, and assigning dependent and independent variables. Variables can include mass, motion, and forces. 8.PS2.5 This standard provides students with exposure to Newton's Third Law. Properly labeling forces including subscripts, makes identification of third law pairs of forces more easily identifiable. Proper labels for forces includes an upper case "F" to indicate force, followed by subscripts indicating the type of force (gravitational/weight, friction, normal, tension, etc.), then the object experiencing the force, and finally the object exerting the force. For example, a label for the force of tension acting on a yoyo, suspended by a string is Ft,yo-yo, string (Ft,y,s).		• Bumper Ducks Smithsonian Science Education Center Games • Cannon Recoil (Phenomenon) Video • Inertia Tower Activity • Legends of Learning-Factors Influencing Motion: Newton's First and Second Laws • Four Forces on an Airplane Article • Newton's Second Law cK-12 Content • Newton's Laws of Motion Simulation Investigation Better Lesson • Two-Stage Balloon Rocket Science Buddies Lesson • Push Harder-Newton's Second Law 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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold)

Students often incorrectly identify gravity as the equal and opposite force (Fg,yo-yo,earth) when asked to identify the equal and opposite force acting on the yo-yo described above. This is reasonable because the directions of the tension and weight forces are opposite. However, the correct equal and opposite force for this system would be the force of tension exerted on the string by the yo-yo (Ft,s,y). Equal and opposite force will always be of the same type. In this case, both pairs were tension forces, as opposed to the incorrect pairing of a gravity/weight force with a tension force. If forces are accurately labeled, the labels will be identical, with only the order of the last two subscripts reversed. The correct pair of equal and opposite forces was Ft,y,s and Ft,y,s, not the incorrectly identified pair: Ft,y,s and Fg,y,e. Equal and opposite forces exist whether or not the objects are in moving, and even in a collision where only one object moves (e.g., jumping off the ground). **Suggested Science and Engineering Practice(s)** Developing and Using Models 8.PS2.3, 8.PS2.5 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.		• Students will differentiate between contact forces and forces that act at a distance by using compare and contrast sentence frames. • Students will use a graphic organizer to compare the effect of balanced and unbalanced forces on an object. • Students will use sentence frames and pre-taught vocabulary to explain Newton's first law using the concept of inertia. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) inertia, vector, carried out Sentence Stems: The graphic organizer shows... The graphic organizer shows the difference between balanced and unbalanced objects is…… Newton's law demonstrates that…..

Planning and Carrying out Controlled Investigations 8.PS2.4 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 **Suggested Crosscutting Concept(s)** Systems and System Models 8.PS2.3 Students develop models for systems which include both visible and invisible inputs and outputs for that system. Cause and Effect 8.PS2.4, 8.PS2.5 Students begin to connect their explanations for cause and effect relationships to specific scientific theory.		

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<tr><td>Unit 2, Lesson 1</td><td>Lesson Length</td><td>Essential Question</td><td>Vocabulary</td></tr>
<tr><td>Electric Charge and Static Electricity</td><td>1 week</td><td>What makes something electrically charged?</td><td>electrical charge, static electricity, electrical conductor, electrical insulator, semiconductor</td></tr>
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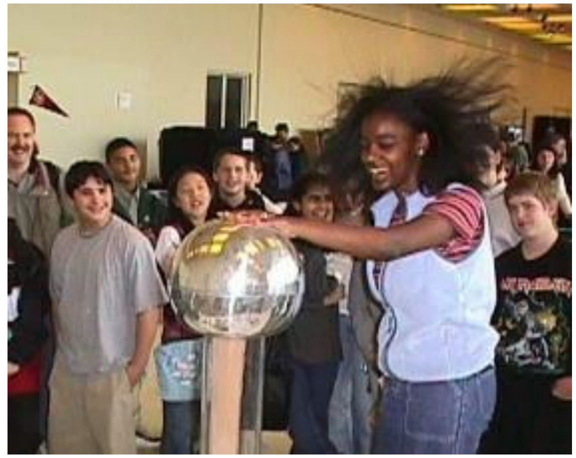
<tr><th>Standards and Related Background Information</th><th>Instructional Focus</th><th>Instructional Resources</th></tr>
<tr><td>DCI(s)
PS2: Motion and Stability: Forces and Interactions

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) and Support of Standard(s) from TN Science Reference Guide
8.PS2.2 Student investigations should center around two objects that can exert a force on each other, even without coming into physical contact, with the intent of building an understanding of fields. The investigations should explore the nature</td><td>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.</td><td>Curricular Resources
HMH Tennessee Science TE, Unit 2, Lesson 1 pp. 70-82
Engage
• Engage Your Brain #s 1and 2, SE p. 51
• Active Reading #s 3 and 4, SE p. 51
Electric Charge
• Observing Static Electricity Activity, TE p. 72
• Water Magic Daily Demo, TE p. 73
Explore
Electric Force
• How Can Static Electric Charges Affect Each Other? Virtual Lab, TE p. 73</td></tr>
</table>

of the force (gravitational, electric, or magnetic) and students should be able to identify which type of field is responsible for the interaction they are investigating. Variables under investigation might include the nature of the object exerting the field, or the distances between the objects (positions in the field). Finally, students should record their observations. Data might take the form of: changes in the motion of an object, the weight suspended in a system, or physically sensing a push or a pull against the student. In conjunction with 8.PS2.4, students can carry out investigations to explore why Earth's gravitational field causes all objects to fall at the same rate. Investigations of electromagnetics/generators might be done concurrent with 8.PS2.1, or evidence of electric fields might be gathered from observations of pith balls around statically charged conductors. **Suggested Science and Engineering Practice(s)** <u>Planning and Carrying out Controlled Investigations</u> 8.PS2.2 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 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! Students can complete a [See Think Wonder Template] after examining the picture.	<u>Explain</u> Electric Charge • Active Reading #5, SE p. 52 • Visualize It! #6, SE p. 52 Electric Force • Active Reading #7, SE p. 53 • Visualize It! #8, SE p. 53 Electric Charge • Active Reading #9, SE p. 54 • Active Reading #10, SE p. 55 • Think Outside the Book #11, SE p. 55 Conductors, Insulators, and Semiconductors • Visualize It! #12, SE p. 56 • Summarize #13, SE p. 57 Electric Charge • Active Reading #14, SE p. 57 <u>Extend</u> 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 <u>Evaluate</u> Formative Assessment • Reteach, TE p. 77 • Throughout TE • Lesson Review, SE p. 59

Suggested Crosscutting Concept(s) Cause and Effect 8.PS2.2 Students use cause and effect relationships to make predictions.		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 **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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold) • Students will talk with a partner to distinguish between the two types of electric charge using a compare/contrast graphic organizer.

		• Students will orally describe the ways in which objects can become electrically charged using a sentence frame and pre-taught vocabulary. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) charge, nature, conservation Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Sentence Stems: When I compared _____, I noticed that... When I compared this year's data with last year's, I noticed that... The difference between... There are similarities between... An electrical charge is…. The properties of an electrical charge are… Additionally,_ has/have ... ______ is an example of… ______ is an example of....because ... For Labs and partner work, consider providing these stems: Question Starters What's the connection between….?

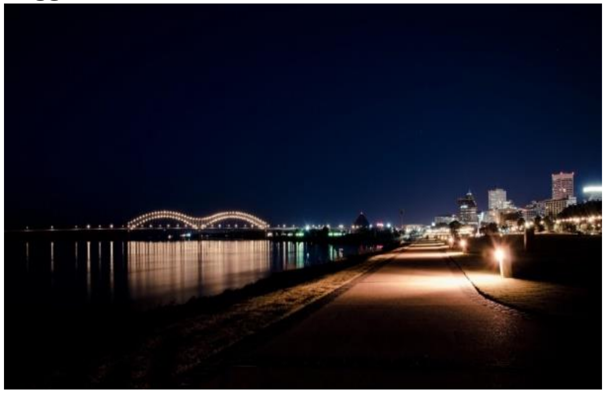
		What link do you see between… Why do you think…? What is our evidence that…. Do we have enough evidence to make that claim? But what about this other evidence that shows…? But does your claim account for…(evidence) <u>Response Starters</u> I agree with you because of (evidence or reasoning) I don't agree with your claim because of (evidence or reasoning) This evidence shows that… Your explanation makes me think about …..

8th Grade Quarter 1 Curriculum Map						
Quarter 1			Quarter 2		Quarter 3	Quarter 4
Structures & Routines	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
1 week	4 weeks	**5 weeks**	4 weeks	5 weeks	9 weeks	9 weeks

UNIT 2: Electricity and Magnetism (5 weeks)
Overarching Question(s)
How can one explain and predict interactions between objects and within systems of objects?

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 Resources**
DCI(s) 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) and Support of Standard(s) from TN Science Reference Guide** 8.PS2.2 Student investigations should center around two objects that can exert a force on each other, even without coming into physical contact, with the intent of building an understanding of fields. The investigations should explore the nature of the force (gravitational, electric, or magnetic)	**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.	**Curricular Resources** HMH Tennessee Science TE, Unit 2, Lesson 2 pp. 84-95 Engage • Engage Your Brain #s1 and 2, SE p. 92 • Active Reading #s 3 and 4, SE p. 92 Explore Current • Investigate Electric Current Quick Lab, TE p. 87 Explain Current • Active Reading #5, SE p. 62 • Visualize It! #6, SE p. 62 • Active Reading #7, SE p. 62 Voltage • Visualize It! #8, SE p. 64

and students should be able to identify which type of field is responsible for the interaction they are investigating. Variables under investigation might include the nature of the object exerting the field, or the distances between the objects (positions in the field). Finally, students should record their observations. Data might take the form of: changes in the motion of an object, the weight suspended in a system, or physically sensing a push or a pull against the student. In conjunction with 8.PS2.4, students can carry out investigations to explore why Earth's gravitational field causes all objects to fall at the same rate. Investigations of electromagnetics/generators might be done concurrent with 8.PS2.1, or evidence of electric fields might be gathered from observations of pith balls around statically charged conductors. **Suggested Science and Engineering Practice(s)** Planning and Carrying out Controlled Investigations 8.PS2.2 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 Phenomenon**  Electric current sent over wires from power plants throughout Memphis supply our city with energy for lights and other uses. Students can complete a See Think Wonder Template after examining the picture.	Extend Reinforce and Review • Cluster Diagram Graphic Organizer, TE p. 90 • Visual Summary, SE p. 66 Evaluate Formative Assessment • Reteach, TE p. 91 • Throughout TE • Lesson Review, SE p. 67 Summative Assessment • Electric Currents Alternate Assessment, TE p. 91 • Lesson Quiz **Additional Resources** • Levitation Engineers • 8.PS2.2 Student Activity and Teacher Guide **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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals

Suggested Crosscutting Concept(s) Cause and Effect 8.PS2.2 Students use cause and effect relationships to make predictions.		Sample Language Objectives: (language domain along with a scaffold) • Students will use a sentence frame to describe electric current. • Students will use a graphic organizer to compare direct to alternating current, and describe some everyday devices that use each in writing. • Students will talk with a partner to describe voltage and its relationship to electric current using visuals and pre-taught vocabulary. Pre-teach vocabulary: Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) relationship, voltage, alternating, current, resistance, device Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Sentence Stems: When I compared _____, I noticed that... When I compared this year's data with last year's, I noticed that... The difference between... There are similarities between...

		An electrical charge is…. The properties of an electrical charge are… Additionally,_ has/have ... ________ is an example of… ________ is an example of....because ...

8th Grade Quarter 1 Curriculum Map							
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1 week	4 weeks	**5 weeks**	4 weeks	5 weeks	9 weeks	9 weeks	

UNIT 2: Electricity and Magnetism (5 weeks)			
Overarching Question(s)			
How can one explain and predict interactions between objects and within systems of objects?			
Unit 2, Lesson 3	**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 Resources**
DCI(s) 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.	**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.	**Curricular Resources** HMH Tennessee Science, TE Unit 2, Lesson 4 pp. 114-126 Engage • Engage Your Brain #s 1 and 2, SE p. 85 • Active Reading #s 3 and 4, SE p. 85 Properties of Magnets • Magnets at Work Activity, TE p. 116 • Magnet Power Probing Question, TE p.116 • Making Magnets Quick Lab, TE p. 117 Properties of Magnetic Fields • Seeing Magnetic Fields Daily Demo, TE p. 117 • Studying Magnetism Quick Lab, TE p. 117

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

8.PS2.1 Student investigations should be built around questions that the students ask in order to understand the cause and effect relationship in electromagnetic devices. The relationship between electricity and magnetism is reciprocal, so investigations should include systems that convert electricity into magnetism, as well as systems that create magnetism into electricity.

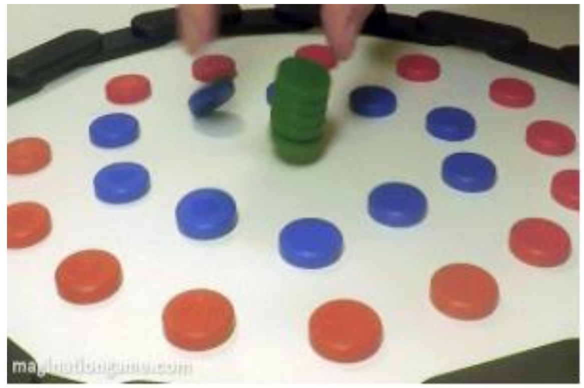
For systems that convert electricity into magnetic force student should ask testable questions about the impacts of: the strength of the magnetic field (a result of factors such as current in the wire or loops in a coil), distances between the interacting objects, orientation of resulting objects, and the magnetic strength of the objects. Outcomes of these investigations should permit students to understand that the magnetic field can vary in strength as well as north-south polarity.

The same sets of variables can be used to understand induction. Polarities either in wires or coils of wire can be observed using a compass. From experimental results, students should also be able to predict the behavior in systems they design.

8.PS2.2 Student investigations should center around two objects that can exert a force on each

- Explain how Earth's geographic and magnetic poles differ.

Suggested 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. Students can complete a See Think Wonder Template after watching the video.

Explore
Types of Magnets
- Magnetic Attraction Activity, TE p. 116

Explain
Properties of Magnets
- Infer #5, SE p. 86
- State #6, SE p. 86
- Visualize It! #7, SE p. 87
- Visualize It! #8, SE p. 87

Properties of Magnetic Fields
- Visualize It! #9

Types of Magnets
- 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

Extend
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

Evaluate
Formative Assessment
- Reteach, TE p. 121
- Throughout TE
- Lesson Review, SE p. 93

other, even without coming into physical contact, with the intent of building an understanding of fields. The investigations should explore the nature of the force (gravitational, electric, or magnetic) and students should be able to identify which type of field is responsible for the interaction they are investigating. Variables under investigation might include the nature of the object exerting the field, or the distances between the objects (positions in the field). Finally, students should record their observations. Data might take the form of: changes in the motion of an object, the weight suspended in a system, or physically sensing a push or a pull against the student. In conjunction with 8.PS2.4, students can carry out investigations to explore why Earth's gravitational field causes all objects to fall at the same rate. Investigations of electromagnetics/generators might be done concurrent with 8.PS2.1, or evidence of electric fields might be gathered from observations of pith balls around statically charged conductors.		Summative Assessment • Magnetic Madness Alternative Assessment, TE p. 121 • Lesson Quiz **Additional Resources** • 8.PS2.1 Student Activity and Teacher Guide • 8.PS2.2 Student Activity and Teacher Guide • Electric Train Video • Legends of Learning-Electric and Magnetic Forces **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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold) • Students will use a sentence frame and word box to describe the properties of magnets in writing.

Suggested Science and Engineering Practice(s) Asking Questions (for Science) and Defining Problems (for Engineering) 8.PS2.1 Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. Planning and Carrying out Controlled Investigations 8.PS2.2 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)** Cause and Effect 8.PS2.1 Students begin to connect their explanations for cause and effect relationships to specific scientific theory. 8.PS2.2 Students use cause and effect relationships to make predictions.		• Students will talk with a partner to explain what magnetic poles and magnetic fields are using a diagram and sentence frame. • Students will describe how magnets attract and repel using a graphic organizer and word box. Pre-teach vocabulary: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) field, repel, pole, attract, magnet versus magnetic, acts as Model speaking and writing expectations for Entering Level ELs. Consider using the recommended stems to support students in their discussions and writing. Sentence Stems: The properties of magnets are….. It is important to remember that magnets are… Magnets attract by……and…… Magnets repel by…… 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?

8th Grade Quarter 1 Curriculum Map						
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1 week	4 weeks	**5 weeks**	4 weeks	5 weeks	9 weeks	9 weeks

UNIT 2: Electricity and Magnetism (5 weeks)			
Overarching Question(s)			
How can one explain and predict interactions between objects and within systems of objects?			
Unit 2, Lesson 4	**Lesson Length**	**Essential Question**	**Vocabulary**
Electromagnetism	1.5 weeks	What underlying forces explain the variety of interactions observed? *What is electromagnetism?*	electromagnetism, electric motor, electromagnetic induction, solenoid, transformer, electromagnet, electric generator
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
DCI(s) 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		**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 Resources** HMH Tennessee Science, TE Unit 2, Lesson 5 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

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. **Explanation(s) and Support of Standard(s) from TN Science Reference Guide** 8.PS2.1 Student investigations should be built around questions that the students ask in order to understand the cause and effect relationship in electromagnetic devices. The relationship between electricity and magnetism is reciprocal, so investigations should include systems that convert electricity into magnetism, as well as systems that create magnetism into electricity. For systems that convert electricity into magnetic force student should ask testable questions about the impacts of: the strength of the magnetic field (a result of factors such as current in the wire or loops in a coil), distances between the interacting objects, orientation of resulting objects, and the magnetic strength of the objects. Outcomes of these investigations should permit students to understand that the magnetic field can vary in strength as well as north-south polarity.	**Suggested Phenomena**  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. Students can complete a See Think Wonder Template after watching the video.	• Building an Electromagnet Quick Lab, TE p. 131 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 • Building a Speaker S.T.E.M. Lab, TE p. 131 Extend Reinforce and Review • Mind Map Graphic Organizer, TE p. 134 • Visual Summary, SE p. 120 Going Further • 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

The same sets of variables can be used to understand induction. Polarities either in wires or coils of wire can be observed using a compass. From experimental results, students should also be able to predict the behavior in systems they design.

8.PS2.2 Student investigations should center around two objects that can exert a force on each other, even without coming into physical contact, with the intent of building an understanding of fields. The investigations should explore the nature of the force (gravitational, electric, or magnetic) and students should be able to identify which type of field is responsible for the interaction they are investigating.

Variables under investigation might include the nature of the object exerting the field, or the distances between the objects (positions in the field). Finally, students should record their observations. Data might take the form of: changes in the motion of an object, the weight suspended in a system, or physically sensing a push or a pull against the student.

In conjunction with 8.PS2.4, students can carry out investigations to explore why Earth's gravitational field causes all objects to fall at the same rate. Investigations of electromagnetics/generators might be done concurrent with 8.PS2.1, or

The fire doors in this video automatically close, because the electromagnet holding them open is released by the fire alarm. Click on the picture above to see the fire doors close automatically. Students can complete a [See Think Wonder Template] after watching the video.

Evaluate

Formative Assessment
- Reteach, TE p. 135
- Throughout TE
- Lesson Review, SE p. 121

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
- The Good, the Bad and the Electromagnet
- Current and Magnetism cK-12 Content
- Electromagnet cK-12 Content
- Electric Motor cK-12 Content
- What Factors Affect the Strength of an Electromagnet? Lesson
- Electromagnets Better Lesson
- Stripped-Down Generator Exploratorium Science Snack
- Stripped-Down Motor Exploratorium Science Snack
- Magnets and Electromagnets PhET Simulation

evidence of electric fields might be gathered from observations of pith balls around statically charged conductors. 8.ETS1.1 Within the field of engineering, models are often prototypes. The purpose of on-going testing of prototypes is to permit a variety of tests of a solution or a set of competing solutions. Data from each of the different tests can then be compiled and compared to either improve a particular design, or select from a group of designs. An optimal design may not be the best performer on all tests, but if tests are designed with respect to the criteria and constraints for the design task, it is possible to accept compromises in light of project priorities. Motors and generators both allow conversions between mechanical energy and electrical energy, but in different directions. Motors convert electrical energy into motion, while generators convert the energy of motion into electrical energy. This standard bundles well with 8.PS2.1, and testing and optimization of either type of device can as a way of exploring the patterns underlying principles of electromagnetism. Examples of models may include creating, testing, and modifying simple electromagnets, using a coil of wire and a magnet to produce electric current,		**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 When applicable - use Home Language to build vocabulary in concepts. Spanish Cognates Interactive Science Dictionary with visuals Sample Language Objectives: (language domain along with a scaffold) • Students will use a word box to describe electromagnetism to a partner. • Students will use a sentence frame to write to describe a solenoid and how it works. • Students will use a step sheet to write and talk to describe what an electromagnet is and how one is constructed. Pre-teach: (Consider teaching this vocabulary in addition to vocabulary addressed in the standard to support Entering Level ELs) works, construct, device, in conjunction with Model speaking and writing expectations for Entering Level ELs. Consider using the

or creating a simple homopolar electric motor with magnets, a battery and paper clips. **Suggested Science and Engineering Practice(s)** Asking Questions (for Science) and Defining Problems (for Engineering) 8.PS2.1 Questions originate based on experience as well as need to clarify and test other explanations, or determine explicit relationships between variables. Planning and Carrying out Controlled Investigations 8.PS2.2 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. Obtaining, Evaluating, and Communicating Information 8.ETS1.1 (O/E) Students can evaluate text, media, and visual displays of information with the intent of clarifying claims and reconciling explanations. (C) Students can communicate scientific information in writing utilizing embedded tables, charts, figures, graphs. **Suggested Crosscutting Concept(s)** Cause and Effect 8.PS2.1 Students begin to connect their explanations for cause and effect relationships to specific scientific theory.		recommended stems to support students in their discussions and writing. Sentence stems: A science term that describes ______ is______ I might be able to use the word____ when___, because ... I probably would not use the word ____ when ___, because ... One characteristic of ____ is... To describe: Use adverbs such as first, second, next, then, finally. Brainstorming ideas: First I will ______ , and then ________ I will ______. I will need to ________.

8.PS2.2 Students use cause and effect relationships to make predictions. Scale, Proportion, and Quantity 8.ETS1.1 Students make and evaluate derived/proportional measurements.		