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.

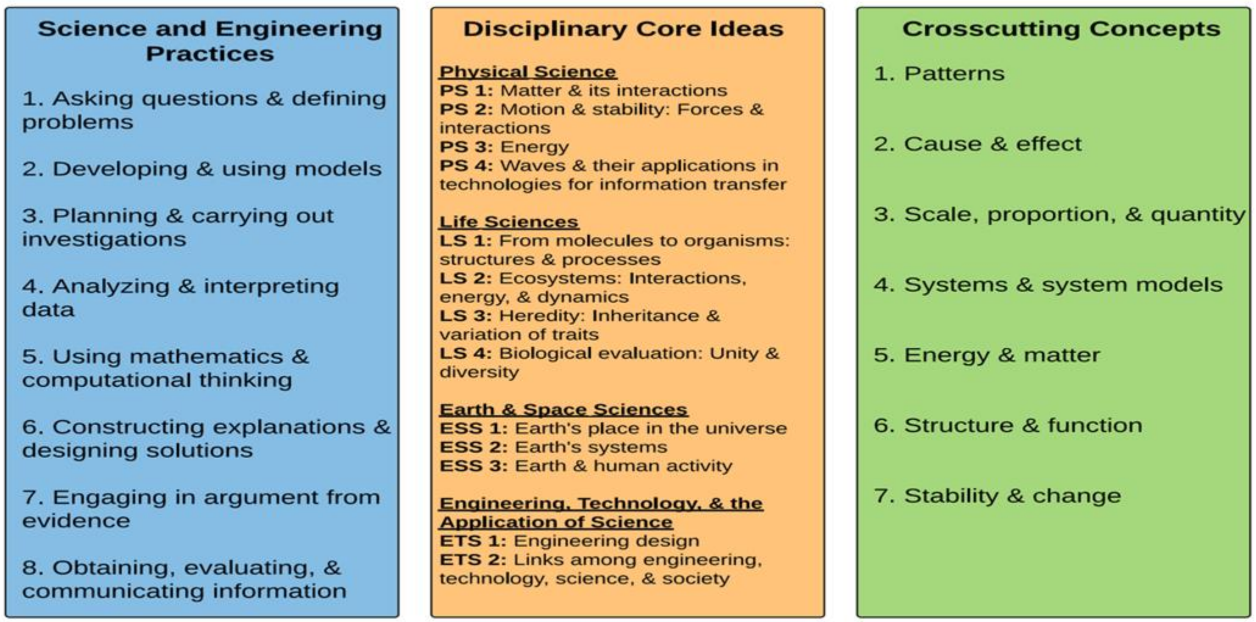
Introduction
In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we 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.



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.

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

UNIT 3 Motions and Stability [9weeks]			
Overarching Question(s)			
What factors affect the velocity of an object?			
Unit	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 3 Motions and Stability	**Length** [20 DAYS]	**Essential Questions** • How are distance and displacement different? • How is an object's speed calculated? • What information does a distance-time graph provide? • What is the difference between speed and velocity? • How is the motion of two objects relative to each other described? • How can an object's momentum be calculated? • How are acceleration, time, and velocity related? • What are three ways an object can accelerate? • How can an object's acceleration be calculated? • What are the similarities and differences between straight line motion, circular motion, and projectile motion? • How can motion be observed, described, measured and represented? • How do we model acceleration motion? • How do different speeds look on different graphs? • What information is given on a v-t graph?	Motion, Displacement, Speed, Velocity, Momentum, Acceleration, Centripetal acceleration, Meter
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**

DCI

PS2: Motion and Stability: Forces and Interactions

Standard

PSCI.PS2.1 Use mathematical representations to show how various factors (e.g., position, time, direction of force) affect one-dimensional kinematics parameters (distance, displacement, speed, velocity, acceleration). Determine graphically the relationships among those one-dimensional kinematics parameters.
PSCI.PS2.2 Algebraically solve problems involving constant velocity and constant acceleration in one-dimension

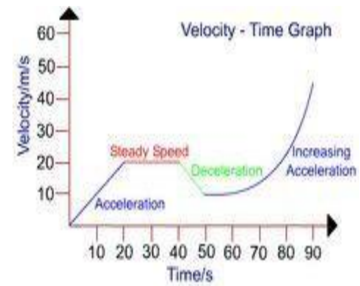
Explanation

Discussions should lead students to differentiate between motion, velocity, momentum and acceleration. In eighth grade, standard 8.PS2.3 provides limited exposure to the different approaches to modeling the motion of an object. At that time, the focus was on creating the representations. Students should not be able to explain and translate between models that include the motion of multiple objects on the same graph. It is also appropriate to introduce the concepts of derivatives (slopes) and integrals (areas under curves) to aid in the process transforming between representations. Students can use the models they have developed to evaluate systems. For a system to undergo constant acceleration, the net force on the object must be constant throughout the problem. Problem solving should be extended to include proportional reasoning, beyond simple manipulation of variables.

Misconceptions

- Students may think that distance and displacement are the same. The terms sound similar, which

Essential Questions



- What does the slope of a v-t graph tell us?

Learning Outcomes

- Demonstrate the relationship between speed and velocity.
- Investigate the factors that determine the speed of an object rolling down a ramp.
- Distinguish between speed and velocity.
- Interpret a position-time graph for velocity or a velocity-time graph for acceleration.
- Solve application problems related to velocity and acceleration, using appropriate
  units of measurement (v=d/t, a=Δv/t).
- Effectively solve for variables in problems involving velocity, acceleration,
  force, and momentum.
- Collect data to construct, analyze, and interpret graphs for experiments that involve
- distance, speed, velocity, and time

Phenomenon

View the phenomenon videos and choose which ones to show to students.
Motion Phenomenon – Woodpecker in Slow Motion, Sailing Stones, Slinky Free Fall, Human Loop, Snow Donuts, Sound barrier, and Changing Forces. https://www.ngssphenomena.com/search?q=motion

The Unexplainable Magnetic Phenomenon – 9 Amazing Magnets 6:03 minutes; Fiery Looping Rain on the Sun 4.17 minutes; Non-Newtonian Fluid on a Speaker Cone 1:18 minutes; Amazing Discovery with Magnets 2:14 min. https://www.ngssphenomena.com/magnetic-rotation/2016/3/12/magnetic-rotation

Acceleration Phenomenon – Sound Barrier

Curricular Resources

Engage Which Way Does It Go?

Explore Virtual Lab: Describing Motion
Mini Lab: Measure Average Speed

Explain Motion Graphs Lab

Elaborate The Momentum of Colliding Object Lab A or Lab B

Evaluate Look Mom! No Hands! Web Quest

Glencoe Physical Science
Chapter 2 – Motion
2.1 Describing Motion
Describing Motion Video found in Chapter 2 Section 1 resources.
Describing Motion Virtual Lab found in Chapter 2 Section 1 resources.
Describing Motion Reinforcement Activity questions 1-10 found in Chapter 2 Section 1 resources.
Section 1 Focus – Reading Preview – Tie in to Prior Knowledge, page 44.
Main Idea – Comparing Speeds, page 44.
Visual Learning – Help students understand information presented in Figure 3, page 45.
Reading Strategy – Have students read **Adding Displacements** in pairs. page 46.
Review Example problem 1 on page 47. Assign problems 1-3 on page 47.
Review Speed Changing over Distance graph, Figure 5 on page 48.
Review Distant-Time Graph Figure 7 on page 49.
Virtual Lab (d = st) What is the relationship between distance, average speed, and time? OL page 47
Quick Demo Car Ramps page 47.
Mini Lab Students will calculate the average speed of a mini car page 48.
Khan Academy – Introduction to Motion (9:10 minute Video) - https://www.youtube.com/watch?v=8wZugqi_uCg
Khan Academy – Choosing kinematic equations(10:57 minute Video) - https://www.khanacademy.org/science/ap-physics-1/ap-one-dimensional-motion/motion-with-constant-acceleration/v/choosing-kinematic-equations

may cause students' confusion. Remind them that distance is the length traveled while displacement is the distance and direction between the initial position and the final position. • Students sometimes interpret the height of a distance-time graph as its slope. The steepness of the straight line of a distance-time graph is the slope. This shows the speed. The height of the line is the farthest distance the object has traveled in the positive direction. • Students do not see motion as belonging to a number of different categories at rest, constant velocity, speeding up, slowing down, changing direction, etc. Instead, they see motion as moving or not moving. • Students think that if speed is increasing that acceleration is also increasing. • Students regard objects at rest as being in a natural state in which no forces are acting on the object. • Students who recognized a holding force, differentiated it from pushing or pulling forces. • Students think air pressure, gravity, or an intervening object (like a table) is in the way keeps and object stationary. • Students think that the downward force of gravity must be greater than an upward force for the book to be stationary. **Science and Engineering Practice** **Asking questions**	https://www.ngssphenomena.com/search?q=speed	Khan Academy – Average velocity for constant acceleration (14:09 minute Video) - https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic-formulas/v/average-velocity-for-constant-acceleration **2.2 Velocity and Momentum** **Velocity and Momentum Video** found in Chapter 2 Section 2 resources run time 5:03 minutes. **Velocity and Momentum Animation Motion Video** found in Chapter 2 Section 2 resources run time 20 seconds. **Velocity and Momentum Reinforcement Activity** questions 1-8 found in Chapter 2 Section 2 resources. **Section 2 Focus 1 – Reading Preview** – Tie in to Prior Knowledge, Distance and Displacement on page 51. **Main Idea** – Escalators, page 51 **Visual Learning** – Have students visit connected.mcgraw-hill.com to view the animations about the motion of Earth's plates. **Reading Strategy** – **Determine Importance -** After students read about momentum, ask them to come up with three points they think are important in this section and why p. 54. **Review** Example problem 2 on page 54. Assign problems 12 - 15 on page 54. **Review** Figure 4 on page 55 and discuss the difference in momentum in the figures. **Review** problems 16 – 18; Section 2 on page 55. **Mini Lab** Students will determine the direction of acceleration page 57. Khan Academy - Introduction to momentum (9:18 minute Video) - https://www.khanacademy.org/science/ap-physics-1/ap-linear-momentum/introduction-to-linear-momentum-and-impulse-ap/v/introduction-to-momentum Khan Academy – Force and Time Graphs (8:14 minute Video) - https://www.khanacademy.org/science/ap-physics-1/ap-linear-momentum/introduction-to-linear-momentum-and-impulse-ap/v/force-vs-time-graphs Khan Academy – Impulse and momentum dodgeball example (10:33 minute Video) - https://www.khanacademy.org/science/physics/linear-momentum/momentum-tutorial/v/impulse-and-momentum-dodgeball-example **2.3 Acceleration** **Acceleration Animation Video Throwing and Dropping a Ball** found in Chapter 2 Section 3 resources.

Questions originate based on experience as well as need to clarify and test other explanations or determine explicit relationships between variables. **Developing and using models** Students create models which are responsive and incorporate features that are not visible in the natural world but have implications on the behavior of the modeled systems and can identify limitations of their models. **Planning and Carrying out controlled investigations** Students plan and perform investigations to aid in the development of a predictive model for interacting variables, considering the quantity of data with respect to experimental uncertainty, and select methods for collection and analysis of data. **Using mathematics and computational thinking** Students can create computational or mathematical models for interactions in the natural world using unit equivalencies. **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion. **Crosscutting Concept** **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales. **Systems and System Models**		**Brain Pop Video on Acceleration** found in Chapter 2 Section 3 resources **Acceleration Reinforcement Activity** questions 1-10 found in Chapter 2 Section 3 resources. **Section 3 Focus 1 – Reading Preview** – Relate the function of the accelerator to the motion of a car. page 5. **Visual Learning** – Have students look at figure 19 on page 60 and point out that the spacing of the balls with respect to the horizontal is identical. This shows that the balls have the same vertical acceleration. The horizontal and vertical acceleration are separate. **Daily Intervention** – Check for understanding page 60 **Review** 2 Teach Visual Learning on page 57 **Review** Figure 16 on page 57 and discuss the speed of Tamara's car. **Lab – Motion Graphs** Students will make a distance-time graph of the motion of a toy car page 61 **Khan Academy** – Acceleration (9:06 minute Video) - https://www.khanacademy.org/science/ap-physics-1/ap-one-dimensional-motion/average-and-instantaneous-acceleration/v/acceleration **Khan Academy** – Acceleration vs. time graphs (14:38 minute Video) - https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration-tutorial/v/acceleration-vs-time-graphs **Khan Academy** – Airbus A380 take-off time (8:08 minute Video) - https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration-tutorial/v/airbus-a380-take-off-time **Lessons** https://wolfriver.org/ecology **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Students design or define systems to evaluate a specific phenomenon or problem.		

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5 weeks	4 weeks	9 weeks	3 weeks	4 weeks	2 weeks	4 Weeks	5 Weeks

UNIT 3 Motions and Stability [9 weeks]			
Overarching Question(s)			
What impact does force have upon objects?			
Unit	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 3 Motions and Stability	Length [25 DAYS]	**Essential Questions** • How are force and motion related? • Why is there friction between objects? • What are Newton's Laws of Motion? • What is the relationship between mass, force and acceleration? • How do free body diagrams allow us to analyze objects in motion and at rest? • How does Newton's first law of motion explain what happens in a car crash? • How does Newton's second law of motion explain the effects of air resistance?	force, newton, net force, friction, static friction, sliding friction, rolling friction, fluid friction, field, gravity, weight, Newton's first law of motion, inertia, mass, Newton's second law of motion, Newton's third law of motion, air resistance, terminal velocity, free fall, centripetal force, momentum, law of conservation of momentum
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**
DCI		**Learning Outcomes**	**Curricular Resources**

PS2: Motion and Stability: Forces and Interactions **Standard** PSCI.PS2. 3 Use free-body diagrams to illustrate the contact and non-contact forces acting on an object. PSCI.PS2.4 Plan and conduct an investigation to gather evidence and provide a mathematical explanation about the relationship between force, mass, and acceleration. Solve related problems using F=ma. PSCI.PS2.5 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. PSCI.PS2.6 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on an object during a collision. **Explanation** The concept of net force and Newton's laws have been introduced in 8.PS2.3 and 8.PS2.4. At that time, free-body diagrams are introduced as a tool to represent the forces acting on an object. In further developing the use of free-body diagrams, it is now appropriate to include vectors that must be evaluated to parallel and perpendicular components. At this level, students should understand forces between objects and at the macroscale the motion of a single object experiencing forces is governed by Newton's second law of motion, F=ma. In physics, students learn that the law requires revision for speeds close to the speed of light and subatomic scales. Students should understand that total momentum is a conserved quantity in an isolated system of interacting objects because any change in momentum of one object is balanced by an equal and	• Distinguish between mass and weight. • Distinguish among the concepts inherent in Newton's three laws of motion. • Create models that represent Newton's three laws of motion. • Solve application problems related to acceleration and force using appropriate units of measurement (F=ma). • Choose a correct representation of the Law of Conservation of Momentum. **Phenomenon** **Sample 1** Everyday people get into planes, trains, and automobiles to travel across the globe relying on the understanding of science to get them there safely. We will view news coverage of Amtrak derailments and listen for the science that is considered as it relates to forces and motion and then we'll read an article from Scientific American. View the videos and choose which to show your students. Deadly Amtrak Derailment: Train Was Going 80 In A 30 MPH Zone | TODAY 2:49 mins https://www.youtube.com/watch?v=55osO7x_hJE Amtrak derailment: Listen to conductor's call 13:32 mins https://www.youtube.com/watch?v=bcUwbvyJKUg **CNN** Was speed to blame for Amtrak derailment? 1:24 mins https://www.youtube.com/watch?v=c9dpLEuLxC4 **Scientific American Article** The Amtrak Derailment and Newton's First Law *If speed was the problem, then here is the physics of what may have happened*	Engage Why Can a Bird Fly, But Not I? Explore MiniLab: Compare Friction Virtual Lab: Force and Newton's Laws Virtual Lab: Motion, Forces, and Simple Machines Explain Conservation of Momentum The Effects of Air Resistance Elaborate That'll Be the Day WebQuest Evaluate Egg Heads Engineering Design Motion from Different Forces Lab A or Lab B **Glencoe Physical Science** **Chapter 3 – Forces and Newton's Laws** **3.1 Forces** **Video Lab Force and Acceleration** Explore the relationship between force, mass, and acceleration. This video lab is found on the my.mheducation.com site for Chapter 3 Section 1 of the text under resources. **Khan Academy** Balanced and Unbalanced Forces https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces **Khan Academy** Unbalanced Forces and Motion https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/unbalanced-forces-and-motion **MiniLab** Compare Friction and Gravity p. 76 **Friction Predictions Laboratory Activity** Students observe and compare the forces needed to move an object over different types of surfaces. They also examine the principles of static, sliding, and rolling friction. The handout for this lab is found on the my.mheducation.com site under Chapter Overview for Chapter 3. **Quick Demo** Simulating Gravity p. 77 TE Have students to list examples of when they experience centripetal force in their everyday lives. **Quick Demo** Upward and Downward Forces p. 78 **Collecting Data Activity** To help students become familiar with the relationship between an object's mass and its weight on Earth, have groups of students work together to make a table listing the weights and masses of various objects. Students should first use a balance to determine the object's mass in kilograms, and then calculate the weight by multiplying the mass by 9.8 N/kg.

oppositely directed change in the total momentum of the other objects. To meet the standard PSCI.PS2.6, students should design, evaluate, or refine a device that reduces force during a collision. Evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a safer football helmet, cellular phone packaging, prototype to protect an egg in a freefall drop, or a parachute. **<u>Misconceptions</u>** **Balanced Forces** Students often assume that if an object is not in motion, then no forces are acting on the object. An object that remains motionless does so because balanced forces are acting on it. Students may also assume that an object in motion has an external force acting on it. They should understand that a force is only needed to change an object's motion. **Mass versus Weight** When someone in the U.S. is asked about his/her weight they usual express this in pounds. In Europe and other countries that use the SI system, they express their weight in kilograms, a unit of mass. This is incorrect. Weight should be expressed in Newtons (N). Help students to understand that mass and weight are not the same, but they are related. **Force and Momentum** Sometimes when students are comparing two objects they use force and momentum interchangeably. Help students use scientific terms accurately. **<u>Science and Engineering Practice</u>** **Asking questions** Questions originate based on experience as well as need to clarify and test other explanations or determine explicit relationships between variables.	https://www.scientificamerican.com/article/the-amtrak-derailment-and-newton-s-first-law/ We experience various types of forces as we go about our daily activities. As we study this chapter, you will learn about how forces change the motion of objects. **Sample 2: Opening Teacher Activity/Strategy** **Why can a bird fly, but not I?** Flight is a complex phenomenon involving many different forces. Have students examine the chapter opener image. Explain that some birds, such as hawks and eagles can control their glide through the sky, using air currents, in a way that requires very little exertion and saving energy. Other birds, such as the ostrich cannot fly at all, no matter how hard they flap their wings. They cannot exert sufficient force to lift their mass. And no matter how hard you flap your arms, you will not overcome the force of gravity. Flight requires just the right balance of mass and force. See p. 71 of the text and visit my.mheducation.com site under Chapter Overview for Chapter 3 Results page 2 for more information and an explanation on how to connect the content of each section of back to this phenomenon.	**NASA STEM Engagement Mass vs. Weight Educator Guide** https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Mass_vs_Weight.html Read this blog about how a teacher introduces mass versus weight to her physical science students using this NASA lesson. SmithScience https://smithscience1.wordpress.com/2016/01/02/mass-versus-weight-a-unique-stem-approach/ **Solve for Weight** Practice Problems p. 78 **Free Body Diagrams** Bozeman Science Video https://www.youtube.com/watch?v=gDk2te4nrIo Worksheet: https://www.sfponline.org/Uploads/71/free%20body%20diagram%20worksheet.pdf **<u>3.2 Newton's Laws of Motion</u>** **BrainPop** Newton's Laws of Motion **Professor Dave Explains** Newton's First Law of Motion:Mass and Inertia https://www.youtube.com/watch?v=1XSyyjcEHo0 **Virtual Lab *F = ma*** What is Newton's second law of motion? http://www.glencoe.com/sites/common_assets/science/virtual_labs/E25/E25.html **MiniLab** Observe Inertia p. 81 **Applying Practices Newton's Second Law** Materials needed: Newton spring scales, lab carts, assortment of masses, triple-beam or analytical balance, ramp, motion sensor The handout for this lab can be found on the my.mheducation.com site for Chapter 3 Section 2 of the text under resources. **Solve for Acceleration** Practice problems p. 83 **Quick Demo** Newton's Second Law p. 83 TE **Quick Demo** Newton's Third Law p. 84 TE **Balloon Cars Challenge—Guided-Inquiry Kit** Your students will be thinking like champions with Flinn's Balloon Cars Challenge! Each group constructs and tests an easy-to-assemble balloon-powered car prototype. Next, students use their knowledge of forces and Newton's laws to identify variables that may affect the car's performance. Modifications are then made to the basic design in order to investigate one or more variables. Finally, the redesigned cars are put to the test—who will win the challenge? A fun and memorable activity to engage students in science and engineering practices! Complete for 30 students working in pairs. https://www.flinnsci.com/balloon-cars-challenge---guided-inquiry-kit/ap7922/#variantSpecs **Fan Cart Physics Gizmo** www.explorelearning.com/ Students gain an understanding of Newton's Laws by experimenting with a cart (on which up to three fans are placed) on a linear track. The cart has a mass, as does each fan. The fans exert a constant force when switched on, and the direction of the fans can be altered as the position, velocity, and acceleration of the cart are measured. **Pushing People Around Laboratory Activity** found on the my.mheducation.com site for Chapter 3 Overview with a Lab Manager Icon. Students examine the relationship between force, acceleration, and mass when they use a constant force to pull a skater. **<u>3.3 Using Newton's Laws</u>**

Developing and using models Students create models which are responsive and incorporate features that are not visible in the natural world but have implications on the behavior of the modeled systems and can identify limitations of their models. **Planning and Carrying out controlled investigations** Students plan and perform investigations to aid in the development of a predictive model for interacting variables, considering the quantity of data with respect to experimental uncertainty, and select methods for collection and analysis of data. **Using mathematics and computational thinking** Students can create computational or mathematical models for interactions in the natural world using unit equivalencies. **Constructing explanations and designing solutions** Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion. **Crosscutting Concept** **Cause and Effect** Students use cause and effect models at one scale to make predictions about the behavior of systems at different scales. **Systems and System Models** Students design or define systems to evaluate a specific phenomenon or problem.		**Acceleration Due to Gravity Animation** found in Chapter 3 Section 3 resources run time 2:38 mins. **Drag Force and Terminal Velocity Animation** found in Chapter 3 Section 3 resources run time 36 sec. **Apparent Weight Animation** found in Chapter 3 Section 3 resources run time 2:15 mins. Applying Practices **Problem Based Learning *Egg Heads*** Students create helmets or other protective gear to protect a team of eggheads as they play the sport of free fall. In the sport of free fall, bodiless athletes are dropped to the ground from a height of one meter. After students have achieved the goal of creating a device that protects their eggheads from a one-meter free fall, they refine their designs to protect their eggheads from drops of greater height. Timeframe: **5 days** Applying Practices **Conservation of Momentum** Problem: How does the total momentum of a system before a collision compare to the total momentum after the collision? The materials needed are meter stick, baseball, tennis ball, softball, racquetball, a trough or channel, triple-beam balance, stop watches or timers, and masking tape. **Centripetal Force Inquiry Lab** TE p. 90 Student observe the effect of centripetal force. Centripetal Force Penny demo https://www.stevespanglerscience.com/lab/experiments/centripetal-force-penny/ **Centripetal Force Board** https://www.stevespanglerscience.com/lab/experiments/centripetal-force-board/ **Flinn Activity Centripetal Force Kit** https://www.flinnsci.com/products/physics--physical-science/forces--equilibrium/centripetal-force-activity-kits/ **Quick Demo** Conservation of Momentum p. 91 TE Virtual Lab **Crash!** How is momentum conserved in a vehicle collision? http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.html **Collision Carts Interactive** https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts/Collision-Carts-Notes https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts/Collision-Carts-Interactive Handouts: https://www.simbucket.com/simulation/collision-carts-lab/ **The Effects of Air Resistance Lab** p. 93 The handout for this lab is found on the my.mheducation.com site for Chapter 3 Lab 1. **Professor Dave Explains** Newton's Law of Universal Gravitation https://www.youtube.com/watch?v=kxkFaBG6a-A **Performance Tasks** **Design Your Own Lab** Motion from Different Forces p.94 The handout for this lab is found on the my.mheducation.com site for Chapter 3 Lab 2. **Plan and conduct an investigation** to gather evidence and provide a mathematical explanation about the relationship between force, mass, and acceleration. Solve related problems using F=ma. Teachers visit https://thewonderofscience.com/msps22 for ideas. **Hands-on Activity: Can You Hear Me Now?** **Timeframe: 7 days**

		Students apply their knowledge of linear regression and design to solve a real-world challenge to create a better packing solution for shipping cell phones. They use different materials, such as cardboard, fabric, plastic, and rubber bands to create new "composite material" packaging containers. Teams each create four prototypes made of the same materials and constructed in the same way, with the only difference being their weights, so each one is fabricated with a different amount of material. They test the three heavier prototype packages by dropping them from different heights to see how well they protect a piece of glass inside (similar in size to iPhone 6). Then students use linear regression to predict from what height they can drop the fourth/final prototype of known mass without the "phone" breaking. Success is not breaking the glass but not underestimating the height by too much either, which means using math to accurately predict the optimum drop height. https://www.teachengineering.org/activities/view/uod-1926-linear-regression-design-challenge **Additional Resources** **The Physics Classroom** Balanced and Unbalanced Forces http://www.physicsclassroom.com/class/newtlaws/Lesson-1/Balanced-and-Unbalanced-Forces **Understanding Car Crashes: It's Basic Physics!** This teaching guide will help you to: effectively present the video in your classroom, teach hands-on "crash science" lessons, fulfill curriculum requirements, teach objectives that correlate with national science standards, and stimulate students' interest in modern crashworthiness. Teaching Guide: https://education.ufl.edu/gjones/files/2013/04/teachers_guidePhysics.pdf Video: https://www.youtube.com/watch?v=yUpiV2I_IRI Insurance Institute for Highway Safety https://www.iihs.org/ **Phet Interactive Simulations** Forces and Motion https://phet.colorado.edu/en/simulation/legacy/forces-and-motion **Reasoning's and solutions of Newton's laws** http://www3.ncc.edu/faculty/ens/schoenf/phy101/pdf/Ch4_CQ.PDF **Vernier Physical Science – Newton's Second Law - #39** In this experiment, students use a computer-interfaced Motion Detector to determine acceleration, record and graph data, and make conclusions about the relationship between mass and acceleration. **Lessons** https://wolfriver.org/ecology **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections

		SAT Practice from Khan Academy

Curriculum and Instruction- Science			
RESOURCE TOOLKIT **Quarter 2** **Physical Science**			
Textbook	**DCIs and Standards**	**Videos**	**Additional Resources**
Textbook **Glencoe Physical Science Teacher Edition**	**DCI** PSCI.PS1: Matter and Its Interactions **Standard** PSCI.PS2.1 PSCI.PS2.2 PSCI.PS2.3 PSCI.PS2.4 PSCI.PS2.5 PSCI.PS2.6 PSCI.PS2.7	**Videos** Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The Teaching Channel Teachertube.com	**ACT & SAT** TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy