Department of Teaching & Learning
Fifth Grade Science Curriculum Guide

2018-2019 Fifth Grade Pacing Guide

First Nine Weeks		Second Nine Weeks	
Units	**Topics**	**Units**	**Topics**
Engineering Design 1 week	1. Step to Solving a Problem 2. Developing a Prototype	**Engineering Design/ Links Among Engineering, Technology, Science, and Society** 1 week	1. Facing Failures While Finding Solutions 2. Using Appropriate Tools
From Molecules to Organisms: Structure and Process 2 weeks	1. Animal Reponses- Instinctual and Environmental	**Earth's Place in the Universe- Sun and Other Stars** 2 weeks	1. Physical Characteristics of the Stars 2. Identification of Stars 3. Constellations 4. Galaxies
Heredity: Inheritance and Variation of Traits 3 weeks	1. Inherited Characteristics 2. Environmental Characteristics 3. Transfer of Genetic Information 4. Variations of Traits	**Earth's Place in the Universe- Planets and Moons** 2 weeks	1. Physical Characteristics of Planets and Moons 2. Size/Scale of Planets and Moons 3. Other Celestial Bodies
Biological Change: Unity and Diversity 3 weeks	1. Organisms and Environments Past and Present 2. Common Ancestry 3. Change Over Time	**Earth's Place in the Universe- Relationships between the Sun, Earth, and Moon** 3 weeks	1. Moon Phases and Other Seasonal Changes
		Earth's Place in the Universe- 1 week	1. History of Earth 2. Composition of Earth

Third Nine Weeks		Fourth Nine Weeks	
Units	**Topics**	**Units**	**Topics**
Links Among Engineering, Technology, Science, and Society 1 week	1. Technology: Past, Present, and Future		
Matter and Its Interactions 4 weeks	1. Physical Properties of Matter 2. Changes of State 3. Rate of Change 4. Chemical Change	**Building Bridges** 9 weeks **Engineering Design** **Links Among Engineering, Technology, and Science on Society and the Natural World**	1. Create/Design/Test 2. Original Bridge Design
Motion and Stability: Forces and Interactions 4 weeks	1. Forces 2. Motion 3. The Effect of Earth's Gravity		

Science Training Materials (Go to Teacher Training Materials and Resources and download 5th grade's materials. The lessons that you will download are highlighted in yellow within the Curriculum Guide.)

SEP- Science and Engineering Practice; DCI- Disciplinary Core Idea; CCC- Crosscutting Concept

last updated 08/03/18

Department of Teaching & Learning
Fifth Grade Science Curriculum Guide

Guiding Question: What is the process for developing potential design solutions?

Engineering, Technology, and Applications of Science 1st Nine Weeks- Engineering Design (1 week)			
DCI: 5.ETS1: Engineering Design			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.ETS1.1 Research, test, re- test, and communicate a design to solve a problem. **COMPONENT IDEA:** **B.** Developing Possible Solutions **See page 206 of the Framework, below** **B. What is the process for developing potential design solutions?** The creative process of developing a new design to solve a problem is a central element of engineering. This process may begin with a relatively open-ended phase during which new ideas are generated both by individuals and by group processes such as brainstorming. Before long, the process must move to the specification of solutions that meet the criteria and constraints at hand. Initial ideas may be communicated through informal sketches or diagrams, although they typically become more formalized through models. The ability to build and use physical, graphical, and mathematical models is an essential part of translating a design idea into a finished product, such as a machine, building, or any other working system. Because each area of engineering focuses on particular types of systems (e.g., mechanical, electrical, biotechnological), engineers become expert in the elements that such systems need. But whatever their fields, all engineers use models to help develop and communicate solutions to design problems. Models allow the designer to better understand the features of a design problem, visualize elements of a possible solution, predict a design's performance, and guide the development of feasible solutions (or, if possible, the optimal solution). A physical model can be manipulated and tested for parameters of interest, such as strength, flexibility, heat conduction, fit with other components, and durability. Scale models and prototypes are particular types of physical models. Graphical models, such as sketches and drawings, permit engineers to easily share and discuss design ideas and to rapidly revise their thinking based on input from others. Mathematical models allow engineers to estimate the effects of a change in one feature of the design (e.g., material composition, ambient temperature) on other features, or on performance as a whole, before the designed product is actually built. Mathematical models are often embedded in computer-based simulations. Computer-aided design (CAD) and computer-aided manufacturing (CAM) are modeling tools commonly used in engineering. Data from models and experiments can be analyzed to make decisions about modifying a design. The analysis may reveal performance information, such as which criteria a design meets, or predict how well the overall designed system or system component will behave under certain conditions. If analysis reveals that the predicted performance does not align with desired criteria, the design can be adjusted.	-In order to effectively design a solution for a given problem, it is **imperative that engineers become experts in the relevant fields**. -Students can **use a deliberately crafted problem as a focal point for the design of a solution to the problem**. **-Research driven by the need to solve a problem may provide a way for students to explore new concepts/phenomena**. **-Communication may involve brainstorming possible solutions as well as presenting the results of the designed tests**. -Examples may include using a real-world problem, such as the effects of Hurricane Katrina or Harvey, and having students design solutions using constraints such as time, materials, and space. Other examples may include solutions to areas in a flood zone: dams holding water back, reservoirs storing flood water, levees and embankments preventing overflow, and channel straightening increasing speed of flow. **See page 207 of the Framework, below** **By the end of grade 5.** Research on a problem should be carried out for example, through Internet searches, market research, or field observations—before beginning to design a solution. An often productive way to generate ideas is for people to work together to brainstorm, test, and refine possible solutions. Testing a solution involves investigating how well it performs under a range of likely conditions. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. There are many types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs.	**Macmillan/McGraw-Hill** Technology Lesson 2, page 372 **IXL** -Identify parts of the engineering-design process -Evaluate tests of engineering-design solutions **Britannica** Science Launch Pack: STEM **Other Sites and Sample Activities** -Airplane Challenge -Building with Straws -4 Engineering Challenges -Spaghetti Tower and Marshmallow Challenge -https://buggyandbuddy.com/stem-challenges/ -https://globaldigitalcitizen.org/36-stem-project-based-learning-activities -https://www.middleweb.com/5003/real-world-stem-problems/ **Graphic Organizers** Design Cycle Design Process	**Crosscutting Concept:** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Obtaining, evaluating, and communicating information** Students can communicate technical information about proposed design solutions using tables, graphs, and diagrams.

5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype. **COMPONENT IDEA:** **B.** Developing Possible Solutions *same as 5.ETS1.1	-**Engineered objects are methodically tested before production**. -**Tests are designed to stress certain components** to determine the extremes to which a given component will remain functional. -Student-developed tests should move beyond simply making a device and "trying it out" and should have tests designed to cause failure into a specified component a biomedical engineering example may include creating a prosthetic hand piece using materials such as tape, spoon, paperclips, and foam pieces. -Then, **test the prototype, evaluate, make modifications, and retest**.	**Macmillan/McGraw-Hill** Technology Lesson 2, page 372 **Discovery Education** -Greatest Inventions with Bill Nye: Engineering and Architecture -Picture This: Using Diagrams **Britannica** Science Launch Pack: STEM **Other Sites and Sample Activities** -Prototyping and Model Making -How to Make a Cardboard Prototype -Building and Testing Earthquake-Proof Buildings -The Challenge: Green Design -Prototype the Solution	**Crosscutting Concept:** **Cause and Effect** Students identify conditions required for specific cause and effect interactions to occur through investigation. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Students can identify specific limitations of their models.

Guiding Questions: How do organisms detect, process, and use information about the environment?
What are the differences between physical and behavioral adaptations? How do organisms detect, process, and use information about the environment?

Life Science	**1st Nine Weeks- From Molecules to Organisms: Structure and Process (2 weeks)**		
DCI: 5.LS1: From Molecules to Organisms: Structures and Processes			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.LS1.1 Compare and contrast animal responses that are instinctual versus those that are gathered through senses, processed, and stored as memories to guide their actions. **COMPONENT IDEA:** **D.** Information Processing **See page 149 of the Framework, below** **D. How do organisms detect, process, and use information about the environment?** An organism's ability to sense and respond to its environment enhances its chance of surviving and reproducing. Animals have external and internal sensory receptors that detect different kinds of information, and they use internal mechanisms for processing and storing it. Each receptor can respond to different inputs (electromagnetic, mechanical, chemical), some receptors respond by transmitting impulses that travel along nerve cells. In complex organisms, most such inputs travel to the brain, which is divided into several distinct regions and circuits that serve primary roles, in particular functions such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making. In addition, some of the brain's circuits give rise to emotions and store memories. Brain function also involves multiple interactions between the various regions to form an integrated sense of self and the surrounding world.	**-**This standard builds on a concept that was introduced in kindergarten: the idea that animals and humans have senses (sight, sound, touch) that allow them to gather information about their surroundings. -Now, students should begin to consider that organisms have various types of **sense receptors that gather information by directly interacting with their surroundings**. -Examples of these sense receptors include **photoreceptors, auditory receptors, touch receptors, and taste receptors**. -In animals, information that is gathered may elicit **instinctual responses** or **stored as memories that guide future actions**. Instinctual responses might include **migrations** in response to temperature changes. (Cell types are beyond the scope of this standard and grade level; instead the generic term "sense receptors" is used to describe a group of these cells.) **See page 149 of the Framework, below** **By the end of grade 5.** Different sense receptors are specialized for particular kinds of information, which may then be processed and integrated by an animal's brain, with some information stored as memories. Animals are able to use their perceptions and memories to guide their actions. Some responses to information are instinctive—that is, animals' brains are organized so that they do not have to think about how to respond to certain stimuli.	**Macmillan/McGraw-Hill** Chapter 2 Lesson 3, page 108 **Discovery Education** -Animals Senses -Senses for Survival -Instinctive and Learned Behavior -Animal Adaptations -Senses -Instinct -Concepts in Nature: Adapting to Changes in Nature -Reuters News: Scientists Teach Bees to Play Soccer -Imprinting -Animal Behavior- Word Scramble -Virtual Field Trip- Tundra Connections **IXL** -Introduction to Adaptations -Animal Adaptations: beaks, mouths, and necks -Animal Adaptations: feet and limbs -Animal Adaptations: skins and body coverings **Britannica** -Launch Pack- Animal Behavior -Science Launch Pack- Life Science Living Things: Adaptations -Science Launch Pack- Life Science Living Things: Animal Habitats -Science Launch Pack- Life	**Crosscutting Concept: Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.

		Science Living Things: General -Animal Behavior -Mechanoreception	

Guiding Question: Where do we get our genes? Which traits are inherited from our parents and which do we have instinctual to survive in our environment? How are the characteristics of one generation related to the previous generation? Why do individuals of the same species vary in how they look, function, and behave?

Life Science — 1st Nine Weeks- Heredity: Inheritance and Variation of Traits (3 weeks)

DCI: 5.LS3: Heredity: Inheritance and Variation of Traits

TN State Standards	Objectives/Learning Targets (Explanation)	Instructional Resources	Cross Cutting Concepts and Science and Engineering Principles
5.LS3.1 Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. **COMPONENT IDEA:** **A.** Inheritance of Traits **See page 158 of the Framework, below** **A. How are the characteristics of one generation related to the previous generation?** In all organisms, the genetic instructions for forming species' characteristics are carried in the chromosomes. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. DNA molecules contain four different kinds of building blocks, called nucleotides, linked together in a sequential chain. The sequence of nucleotides spells out the information in a gene. Before a cell divides, the DNA sequence of its chromosomes is replicated and each daughter cell receives a copy. DNA controls the expression of proteins by being transcribed into a "messenger" RNA, which is translated in turn by the cellular machinery into a protein. In effect, proteins build an organism's identifiable traits. When organisms reproduce, genetic information is transferred to their offspring, with half coming from each parent in sexual reproduction. Inheritance is the key factor causing the similarity among individuals in a species population.	-A foundation is being built to explain that **organisms look alike because of genetic controls**. In 2.LS3.1, students observed that parents and offspring look similar and there can be groups (species) of organisms that also resemble each other. -The goal of this standard is to **extend the concept of heredity to explain that some reasons that organisms may look dissimilar are consequences of their environment**. The interactions of an **organism with its environment can extend from diet to learning**. -Examples of this could be the stunted growth of plants with insufficient water, the lack of green color in plants grown without light, a lizard that has lost its tail due to a predator, a dog being overfed or under-exercised becoming overweight. **-The overall appearance and characteristics of an organism are due to a blend of inheritance and interaction.** **See page 158 of the Framework, below** **By the end of grade 5.** Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.	**Macmillan/McGraw-Hill** Chapter 2 Lesson 2, page 98 **Discovery Education** -Genes, Inheritance, and Mutations -Cactus Bees: Building Nests -Cave Specialists **IXL** -Match offspring to parents using inherited traits -Read a plant pedigree chart -Read an animal pedigree chart **Britannica** -Science Launch Pack- Life Science: DNA and Modern Genetics -Heredity -Heredity: incomplete dominance in impatiens -Heredity Videos	**Crosscutting Concept:** Choose a CCC Students routinely search for cause and effect relationships in systems they study **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students create and identify evidence- based arguments and consider whether an argument is supported by evidence or relies on opinions or incomplete representations of relevant evidence.
5.LS3.2 Provide evidence and analyze data that plants and animals have traits inherited from parents and that variations of these traits exist in a group of similar organisms. **COMPONENT IDEA:**	-This standard focuses on a **group of related organisms** and the **traits within those organisms**. -When looking at a particular trait, students should be drawn to observe that there are **multiple variations of a particular trait present**.	**Macmillan/McGraw-Hill** Chapter 2 Lesson 1, page 88 **Discovery Education** -Investigating Heredity -Inheriting Genetic Traits -What Is Genetics?	**Crosscutting Concept: Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Analyzing and interpreting data.** Students should

B. Variation of Traits **See page 160 of the Framework, below** **B. Why do individuals of the same species vary in how they look, function, and behave?** Variation among individuals of the same species can be explained by both genetic and environmental factors. Individuals within a species have similar but not identical genes. In sexual reproduction, variations in traits between parent and offspring arise from the particular set of chromosomes (and their respective multiple genes) inherited, with each parent contributing half of each chromosome pair. More rarely, such variations result from mutations, which are changes in the information that genes carry. Although genes control the general traits of any given organism, other parts of the DNA and external environmental factors can modify an individual's specific development, appearance, behavior, and likelihood of producing offspring. The set of variations of genes present, together with the interactions of genes with their environment, determines the distribution of variation of traits in a population.	-There are **two levels of discussion** appropriate to this standard. The first level of discussion is at a species level, observing that within a **particular species multiple variations of a trait are observable**. -At a higher level, **further variation of the traits are also possible**. -It is appropriate to point out that **organisms will look like their parents** which should permit the inference that information causing the similar appearance is inherited from parents. (Discussions of genetic mechanisms for inheritance and prediction of traits are beyond the scope of this standard.) **See page 160 of the Framework, below** ***By the end of grade 5.*** Offspring acquire a mix of traits from their biological parents. Different organisms vary in how they look and function because they have different inherited information. In each kind of organism there is variation in the traits themselves, and different kinds of organisms may have different versions of the trait. The environment also affects the traits that an organism develops—differences in where they grow or in the food they consume may cause organisms that are related to end up looking or behaving differently.	**IXL** -Identify inherited and acquired traits -Inherited and acquired traits: use evidence to support a statement -Genetics Vocabulary: dominant and recessive -Complete and Interpret Punnett Squares -How do genes and the environment affect plant growth? **Britannica** -Science Launch Pack- Life Science: Genes and Heredity -Mutations -Captive Breeding Program; genetic diversity	organize data (observations and measurements) in a manner which facilitates further analysis and comparisons.

Guiding Questions: What physical characteristics allow an organism to survive in different environments? What evidence shows that different species are related? How do fossils help us to connect the past to the present? How does genetic variation among organisms affect survival and reproduction?

Life Science — 1st Nine Weeks- Biological Change: Unity and Diversity (3 weeks)

DCI: 5.LS4: Biological Change: Unity and Diversity

TN State Standards	Objectives/Learning Targets (Explanation)	Instructional Resources	Cross Cutting Concepts and Science and Engineering Principles
5.LS4.1 Analyze and interpret data from fossils to describe types of organisms and their environments that existed long ago. Compare similarities and differences of those to living organisms and their environments. Recognize that most kinds of animals (and plants) that once lived on Earth are now extinct. **COMPONENT IDEA:** **A.** Evidence of Common Ancestry **See page 162 of the Framework, below** **A. What evidence shows that different species are related?** Biological evolution, the process by which all living things have evolved over many generations from shared ancestors, explains both the unity and the diversity of species. The unity is illustrated by the similarities found between species; which can be explained by the inheritance of similar characteristics from related ancestors. The diversity of species is also consistent with common ancestry; it is explained by the branching and diversification of lineages as populations adapted, primarily through natural selection, to local circumstances. Evidence for common ancestry can be found in the fossil record, from comparative anatomy and embryology, from the similarities of cellular processes and structures, and from comparisons of DNA sequences between species. The understanding of evolutionary relationships has recently been greatly accelerated by using new molecular tools to study developmental biology, with researchers dissecting the genetic basis for some of the changes seen in the fossil record, as well as those that can be inferred to link living species (e.g., the armadillo) to their ancestors (e.g., glyptodonts, a kind of extinct gigantic armadillo).	-Fossils provide evidence for the types of organisms that were found on Earth long ago. -Students are introduced to fossils and the information that they contain about the appearance/structure of organisms that existed long ago in 4.LS4.1. -This standard builds on that background by asking students to **make inferences about the environment where the fossils lived**. -Since both plant and animal materials can become fossilized, **information found in fossils can provide evidence about the environment at the time that organism lived**. **-Inferences can be drawn from sets of fossils found geographically and chronologically near to each other, or by comparing the structure of fossils from extinct organisms to similar organisms still living.** -Such **inferences can include descriptions of both habits and habitats of now extinct organisms**. -An example could include the bottom-dwelling trilobite living mostly in water that was able to curl up much like today's pill bugs. Examples of fossils and their environments could include marine fossils that are now found on land, tropical plant fossils found in the Arctic, and fossils of extinct organisms. **See page 162 of the Framework, below** **By the end of grade 5.** Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences. **Three-Dimensional Learning Performance for Lesson-** Students will use evidence from fossils * in order to describe types of organisms and their environments that existed long ago** highlighting the similarities and differences of extinct organisms to	**Macmillan/McGraw-Hill** Chapter 2 Lesson 4, page 122 Chapter 4 Lesson 1, specifically pages 198-199 **Activity** 5.LS4.1 Engaging in Argument from Evidence Activity **Discovery Education** -Exploring Fossils -Science Kids: All about Natural Selection and Adaptations **IXL** -Introduction to Fossils -Identify and Classify Fossils -Compare Fossils to Modern Organisms -Compare Ancient and Modern Organisms: use observations to support a hypothesis -Interpret Evidence from Fossils in Rock Layers -Label Earth Layers **Britannica** -Science Launch Pack- Fossils -Science Launch Pack- Life Science Animals Dinosaurs and Other Extinct Animals -Science Launch Pack- Living Things: Extinction -Fossil Videos	**Crosscutting Concept: Structure and Function** Students begin to attribute the shapes of sub-components to the function of the part. **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students create and identify evidence- based arguments and consider whether an argument is supported by evidence or relies on opinions or incomplete representations of relevant evidence.

	living organisms and their environments.***	-Prehistoric Sea Monster	
5.LS4.2 Use evidence to construct an explanation for how variations in characteristics among individuals within the same species may provide advantages to those individuals in their survival and reproduction. **COMPONENT IDEA:** **B.** Natural Selection **See page 163 of the Framework, below** **B. How does genetic variation among organisms affect survival and reproduction?** Genetic variation in a species results in individuals with a range of traits. In any particular environment individuals with particular traits may be more likely than others to survive and produce offspring. This process is called natural selection and may lead to the predominance of certain inherited traits in a population and the suppression of others. Natural selection occurs only if there is variation in the genetic information within a population that is expressed in traits that lead to differences in survival and reproductive ability among individuals under specific environmental	-5.LS3 focuses on the idea that inheritance provides a mechanism for both similarity and variation in the appearances of living organisms. -These **changes may provide advantages to certain individuals and species**, **providing a mechanism for large-scale changes over time**. -Though these effects are ongoing, they can be punctuated at times due to catastrophic events. This process which favors certain traits within a population, contributing to the increase in the prevalence of those traits and suppression of others, is known as **natural selection**. -Examples might include rose bushes with longer thorns being less likely to be eaten by herbivores or color variations within a species being favored in certain environments due to benefits	**Macmillan/McGraw-Hill** Chapter 2 Lesson 4, p 122 **Discovery Education** -Natural Selection: Survival of the Fittest -More Science Please: Unusual Evolution of Island Life (Unique Island Ecosystems) -Costa Rica: Frog Adaptations **IXL** -How can animal behaviors affect reproductive success? Identify evidence to support a claim.	**Crosscutting Concept:** **Stability and Change** Students begin to describe changes in terms of time over which they occur; their rate. **SCIENCE AND ENGINEERING PRINCIPLE:** **Obtaining, evaluating, and communicating information** (O/E) Students can read and summarize text and embedded, non-text elements from multiple sources synthesizing an understanding on a scientific idea. (C) Students can communicate scientific information in writing utilizing embedded elements.

conditions. If the trait differences do not affect reproductive success, then natural selection will not favor one trait over others.	such a camouflage. **See page 164 of the Framework, below** ***By the end of grade 5.*** *Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.*	-Construct explanations of natural selection. **Britannica** -Science Launch Pack- Life Science All Living Things: Changes	

First Nine Weeks Resources	
Vocabulary: sense receptors, instinctual responses, adaptation, heredity, inherited traits/characteristics, instincts, variations, extinct, relative age, absolute age, natural selection	
Inquiry Skills: predict, record data, observe, infer, communicate, classify, make a model, compare, draw conclusions	
Plans	**Reproduction, Traits, and Heredity** Understand human traits and animal traits as well as reproduction **Animal Adaptations** Understand how animals and plants adapt to new environments in order to survive.
Background for Teachers	**Reproduction, Traits, and Heredity** **Animal Adaptations** Adaptations are not isolated to animals, plants also adapt.
Other Student Activities	**Reproduction, Traits, and Heredity** Explore activity page 89 Tennessee Science Closer look Macmillan/McGraw-Hill **Animal Adaptations**

	Explore activity page 109 Tennessee Science Closer look Macmillan/McGraw-Hill While using a variety of objects like; oven mittens, chop sticks, spoons etc. try and pick up small and large objects and place them in a container or build a structure to represent animals adapting to change.
Other Sites	**Britannica- Username:** Bartlett **Password:** gopanther1 Science Launch Packs **Discover Ed. Streaming** LIFE: Challenges of Life -Writing Prompts -Teacher's Guide

Guiding Question: What is the process for developing potential design solutions? What are the relationships among science, engineering, and technology?

Engineering, Technology, and Applications of Science 2nd Nine Weeks- Engineering Design (1 week)			
DCI: 5.ETS1: Engineering Design			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.ETS1.3 Describe how failure provides valuable information toward finding a solution. **COMPONENT IDEA:** **B.** Developing Possible Solutions **See page 206 of the Framework, below** **B. What is the process for developing potential design solutions?** The creative process of developing a new design to solve a	-**Failure is essential to both science and engineering**. Without failure it is not possible to understand the limitations or shortcomings of a device or explanation. Students should be encouraged to embrace productive failure as part of the design process to encourage persistent exploration. Scientific discussions might include now revised theories such as vis viva. **See page 207 of the Framework, below** ***By the end of grade 5.*** *Research on a problem should be carried out for example, through Internet searches, market research, or field observations—before beginning to design a solution. An often productive way to generate ideas is for people to work together to brainstorm, test, and refine possible solutions. Testing a*	**Macmillan/McGraw-Hill** **Discovery Education** -Student Engineering Design Sheet -Engineering Lab: Material Tool **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. ***SCIENCE AND ENGINEERING PRINCIPLE:*** **Engaging in argument from evidence** Students make and support claims about a

problem is a central element of engineering. This process may begin with a relatively open-ended phase during which new ideas are generated both by individuals and by group processes such as brainstorming. Before long, the process must move to the specification of solutions that meet the criteria and constraints at hand. Initial ideas may be communicated through informal sketches or diagrams, although they typically become more formalized through models. The ability to build and use physical, graphical, and mathematical models is an essential part of translating a design idea into a finished product, such as a machine, building, or any other working system. Because each area of engineering focuses on particular types of systems (e.g., mechanical, electrical, biotechnological), engineers become expert in the elements that such systems need. But whatever their fields, all engineers use models to help develop and communicate solutions to design problems. Models allow the designer to better understand the features of a design problem, visualize elements of a possible solution, predict a design's performance, and guide the development of feasible solutions (or, if possible, the optimal solution). A physical model can be manipulated and tested for parameters of interest, such as strength, flexibility, heat conduction, fit with other components, and durability. Scale models and prototypes are particular types of physical models. Graphical models, such as sketches and drawings, permit engineers to easily share and discuss design ideas and to rapidly revise their thinking based on input from others. Mathematical models allow engineers to estimate the effects of a change in one feature of the design (e.g., material composition, ambient temperature) on other features, or on performance as a whole, before the designed product is actually built. Mathematical models are often embedded in computer-based simulations. Computer-aided design (CAD) and computer-aided manufacturing (CAM) are modeling tools commonly used in engineering. Data from models and experiments can be analyzed to make decisions about modifying a design. The analysis may reveal performance information, such as which criteria a design meets, or predict how well the overall designed system or system component will behave under certain conditions. If analysis reveals that the predicted performance does not align with desired criteria, the design can be adjusted.	*solution involves investigating how well it performs under a range of likely conditions. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.* *There are many types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs.*		proposed device or solution.

Engineering, Technology, and Applications of Science 2nd Nine Weeks- Links Among Engineering, Technology, Science, and Society

DCI: 5.ETS2: Links Among Engineering, Technology, Science, and Society

TN State Standards	Objectives/Learning Targets (Explanation)	Instructional Resources	Cross Cutting Concepts and Science and Engineering Principles
5.ETS2.1 Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology. **COMPONENT IDEA:** **A.** Interdependence of Science, Technology, Engineering, and Math **See page 210 of the Framework, below** **A. What are the relationships among science, engineering, and technology***?* The fields of science and engineering are mutually supportive, and	-Using tools allows students to acquire two important engineering skills. -Students can gain an **understanding of how tools have enabled humans to build**. -Students acquire **the ability to produce actual prototypes as part of the engineering process**. This skill allows for development of more involved tests of components of a design. **See page 211 of the Framework, below** ***By the end of grade 5.*** *Tools* and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about	**Macmillan/McGraw-Hill** Reference R2-9 **Discovery Education** **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Structure and Function** Students begin to attribute the shapes of sub-components to the function of the part. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Students can create a design plan or prototype of a tool or object which incorporates cause and effect behaviors within the device.

scientists and engineers often work together in teams, especially in fields at the borders of science and engineering. Advances in science offer new capabilities, new materials, or new under-standing of processes that can be applied through engineering to produce advances in technology. Advances in technology, in turn, provide scientists with new capabilities to probe the natural world at larger or smaller scales; to record, manage, and analyze data; and to model ever more complex systems with greater precision. In addition, engineers' efforts to develop or improve technologies often raise new questions for scientists' investigation.	the natural world. Engineering design can develop and improve such technologies. Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. Knowledge of relevant scientific concepts and research findings is important in engineering.		

Guiding Questions: What is the universe, and what goes on in stars? What are the predictable patterns caused by Earth's movement in the solar system? How do people reconstruct and date events in Earth's planetary history? How are the physical characteristics of each planet different? How are the physical characteristics of each planet different?

Earth Science	**2nd Nine Weeks- Earth's Place in the Universe (8 weeks)**		
DCI: 5.ESS1: Earth's Place in the Universe			
2 Weeks- Physical Characteristics of the Stars, Identification of Stars, Constellations, Galaxies			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.ESS1.1 Explain that differences in apparent brightness of the sun compared to other stars are due to their relative distances from the Earth. **COMPONENT IDEA:**	-Our **Sun is an example of a star**, just like the stars that we see in the night sky. The Sun is close enough to illuminate our planet, creating the phenomenon of **daytime**. -Other stars would have similar effects were it not for the immense distance between Earth and these other stars. **The**	**Macmillan/McGraw-Hill** Chapter 3 Lesson 3, page 172 **Activity** 5.ESS1.1 Constructing Explanations and Designing	**Crosscutting Concept:** **Scale, Proportion, and Quantity** Students become familiar with sizes immensely large or small or durations extremely short or long.

A. The Universe and Its Stars **See page 173 of the Framework, below** **A. What is the universe, and what goes on in stars**? The sun is but one of a vast number of stars in the Milky Way galaxy, which is one of a vast number of galaxies in the universe. The universe began with a period of extreme and rapid expansion known as the Big Bang, which occurred about 13.7 billion years ago. This theory is sup- ported by the fact that it provides explanation of observations of distant galaxies receding from our own, of the measured composition of stars and nonstellar gases, and of the maps and spectra of the primordial radiation (cosmic microwave back- ground) that still fills the universe. Nearly all observable matter in the universe is hydrogen or helium, which formed in the first minutes after the Big Bang. Elements other than these remnants of the Big Bang continue to form within the cores of stars. Nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases the energy seen as starlight. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. Stars' radiation of visible light and other forms of energy can be measured and studied to develop explanations about the formation, age, and composition of the universe. Stars go through a sequence of developmental stages—they are formed; evolve in size, mass, and brightness; and eventually burn out. Material from earlier stars that exploded as supernovas is recycled to form younger stars and their planetary systems. The sun is a medium-sized star about halfway through its predicted life span of about 10 billion years.	**difference in distance makes the sun appear much larger than these other stars**. -To appreciate the actual size of the sun relative to these other stars, **students should be familiar with the types and classifications the sun and other stars and basic stellar life cycles**. -A general understanding of star types should include: **main sequence, giants, super giants, and white dwarfs**. -Students can model the effects of distance on the apparent size of objects by taking playground balls out onto the playground/gym/cafeteria/hallway and noting the difference in apparent sizes. -Understanding the different star types sets a foundation for explaining the formation of elements in later grades. (Knowledge of mass and temperature and their effects on stellar life cycle are beyond the scope of this standard, as is a Hertzsprung- Russell Diagram.) **See page 174 of the Framework, below** **By the end of grade 5.** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their size and distance from Earth. **Three-dimensional Learning Performance for Lesson-** Students will develop an explanation* in order to show that the brightness of the sun in comparison to other stars is due to relative distances from earth** highlighting the size and distance of our sun in relation to other stars.***	Solutions Activity **Discovery Education** -The Sun Is a Star -How Far to the Stars? -Size of the Sun -Stars -Life of a Star **IXL** -Analyze models of the Earth-Sun-Moon system **Britannica** -Science Launch Pack- The Sun -Science Launch Pack- Stars -Science Launch Pack- Space Science: The Earth, Moon, and Sun -Science Launch Pack- Space Science: Stars, Galaxies, and the Universe -The Stars -Apparent Brightness Videos -Star Classification -Timeline of a Star	**SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.
5.ESS1.2 Research and explain the position of the Earth and the solar system within the Milky Way galaxy, and compare the size and shape of the Milky Way to other galaxies in the universe. **COMPONENT IDEA:** **A.** The Universe and Its Stars *same as 5.ESS1.1	-Views looking down onto the Milky Way galaxy show several arms radiating outward from the center of the galaxy as well as spurs and bridges connecting these central arms. -Each of these features is notable for their dense populations of stars. **The Milky Way galaxy is located on the Orion Arm** (sometimes called spur). -Many of the **perceived stars visible to the naked eye are actual entire galaxies of stars**. **The Milky Way galaxy is just one type of galaxy in space**. The arrangement of stars in other galaxies can result in different shapes for these galaxies. These shapes include: **spiral, elliptical, lenticular, and irregular**. **Three-dimensional Learning Performance for Lesson-**	**Macmillan/McGraw-Hill** Chapter 3 Lesson 1, page 152 Chapter 3 Lesson 2, page 162 **Activity** 5.ESS1.2 Obtaining, Evaluating, and Communicating Information Activity **Discovery Education** -Earth -A Spin around the Solar System: Look to the Stars -Beyond the Milky Way	**Crosscutting Concept:** **Systems and System Models** Students recognize that large objects are made up of collections of particles. **SCIENCE AND ENGINEERING PRINCIPLE:** **Obtaining, evaluating, and communicating information (Observe/Evaluate)** Students can read and summarize text and embedded, non-text elements from multiple sources synthesizing an understanding on a scientific idea. Students can communicate scientific information in writing utilizing embedded elements.

	Students will obtain, evaluate, and communicate information* in order to show the position of the Earth and the solar system within the Milky Way galaxy**, highlighting the scale of these components in the universe.***	**Britannica** -Science Launch Pack- The Universe -Science Launch Pack- The Solar System -Science Launch Pack- Galaxies -Science Launch Pack- Space Science: The Earth, Moon, and Sun -Science Launch Pack- Space Science: Stars, Galaxies, and the Universe -Galaxies -Solar system: scale of the universe	
2 weeks- Physical Characteristics of Planets and Moons, Size/Scale of Planets and Moons, and Other Celestial Bodies			
5.ESS1.3 Use data to categorize different bodies in our solar system including moons, asteroids, comets, and meteoroids according to their physical properties and motion. **COMPONENT IDEA:** **B.** Earth and the Solar System **See page 175 of the Framework, below** **B. What are the predictable patterns caused by Earth's movement in the solar system?** The solar system consists of the sun and a collection of objects of varying sizes and conditions—including planets and their moons—that are held in orbit around the sun by its gravitational pull on them. This system appears to have formed from a disk of dust and gas, drawn together by gravity. Earth and the moon, sun, and planets have predictable patterns of movement. These patterns, which are explainable by gravitational forces and conservation laws, in turn explain many large-scale phenomena observed on Earth. Planetary motions around the sun can be predicted using Kepler's three empirical laws, which can be explained based on Newton's theory of gravity. These orbits may also change somewhat due to the gravitational effects from, or collisions with, other bodies. Gradual changes in the shape of Earth's orbit around the sun (over hundreds of thousands of years), together with the tilt of the planet's spin axis (or axis of rotation), have altered the intensity and distribution of sunlight falling on Earth. These phenomena cause cycles of climate change, including the relatively recent cycles of ice ages. Gravity holds Earth in orbit around the sun, and it holds the moon in orbit around Earth. The pulls of gravity from the sun and the moon cause the patterns of ocean tides. The moon's and sun's positions relative to Earth cause lunar and solar eclipses to occur. The moon's monthly orbit around Earth, the relative positions of the sun, the moon, and the observer and the fact that it shines by reflected sunlight explain the observed phases of the moon. Even though Earth's orbit is very nearly circular, the intensity of sunlight falling on a given location on the planet's surface changes as it orbits around the sun. Earth's spin axis is tilted relative to the plane of its orbit, and the seasons area result of that tilt. The	**-This standard continues the development of the scale of the bodies found in space.** **-Physical properties of the planets can include their general composition (solid/gas) as well as sizes.** **-Properties of the motion includes their relative positions.** -Clarifications should be made regarding the criteria for classification as a planet. **These criteria include that the body must: orbit the sun, have a nearly round shape, and have significant mass to have cleared its orbital path.** **See page 176 of the Framework, below** **By the end of grade 5.** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year. Some objects in the solar system can be seen with the naked eye. Planets in the night sky change positions and are not always visible from Earth as they orbit the sun. Stars appear in patterns called constellations, which can be used for navigation and appear to move together across the sky because of Earth's rotation. **Three-dimensional Learning Performance for Lesson-** Students will generate scientific questions based on data* in order to show that data can be used to classify the bodies in our solar system ** highlighting the different bodies that make up our solar system.***	**Macmillan/McGraw-Hill** Chapter 3 Lesson 1, page 152 Chapter 3 Lesson 2, page 162 **Activity** 5.ESS1.3 Asking Questions and Defining Problems Activity **Discovery Education** -Junior Space Scientist: Our Solar System -Sun and Stars **IXL** -Analyze data to compare properties of planets **Britannica** -Science Launch Pack- The Planets -Science Launch Pack- The Solar System -Science Launch Pack- Asteroids -Science Launch Pack- Comets -Science Launch Pack- Meteors and Meteorites -Science Launch Pack- Space	**Crosscutting Concept:** **Systems and System Models** Students group and describe interactions of the components that define a larger system. **SCIENCE AND ENGINEERING PRINCIPLE:** **Analyzing and interpreting data.** Students should be able to organize experimental data to reveal patterns and utilize data using simple graph-to- form explanations.

intensity of sunlight striking Earth's surface is greatest at the equator. Seasonal variations in that intensity are greatest at the poles.		Science: The Earth, Moon, and Sun -Celestial Bodies -Science Launch Pack- Space Science: The Solar System	
3 weeks- Moon Phases and Other Seasonal Changes			
5.ESS1.4 Explain the cause and effect relationship between the positions of the sun, earth, and moon and resulting eclipses, position of constellations, and appearance of the moon. **COMPONENT IDEA:** **B.** Earth and the Solar System *same as 5.ESS1.3	**-In addition to daily and seasonal patterns, recording phenomena such as the shape of the moon, the location of constellations in the night sky, and the appearance of the moon reveal patterns as well.** -It is possible to record the changes to the shape of the moon to compare with a smaller model, and with significant advanced planning, an ongoing record could be kept but would take ~28 days for a full cycle to complete. **-Student models should permit explanations for the appearance of the moon as well as eclipse patterns.** **Three-dimensional Learning Performance for Lesson-** Students will develop and use models* in order to show the positions of the sun, earth, and moon during solar and lunar eclipses** highlighting the cause and effect relationship between the positions and resulting eclipses.***	**Macmillan/McGraw-Hill** Chapter 3 Lesson 1, page 152 Chapter 3 Lesson 2, page 162 **Activity** 5.ESS1.4 Developing and Using Models Activity **Discovery Education** -Science Kids: All about the Moon **IXL** -Identify the Phases of the Moon **Additional Sites** Moon Phase Calendar Almanac Moon Phase Calendar **Britannica** -Science Launch Pack- The Phases of the Moon -Science Launch Pack- The Moon -Science Launch Pack- Solar and Lunar Eclipses -Science Launch Pack- Space Science: The Earth, Moon, and Sun -Moon Phases -Sun, Moon, and Earth Relationship Videos -Eclipse Videos -Orbit Phases	**Crosscutting Concept:** **Cause and Effect** Students routinely search for cause and effect relationships in systems they study. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.

5.ESS1.5 Relate the tilt of the Earth's axis, as it revolves around the sun, to the varying intensities of sunlight at different latitudes. Evaluate how this causes changes in day-length and seasons. **COMPONENT IDEA:** **B.** Earth and the Solar System *same as 5.ESS1.3	-In 4.ESS1.2, students were first introduced to the phenomenon of day and night as patterns that they experience daily, having origins in the motion of the earth. **-The cause of the seasons is rooted in the tilt of the earth's axis combined with the effects of variations in the sun's intensity based on the angle that the sun's rays strike the earth**. **Due to the tilt of the Earth's axis, the duration of daylight hours and intensity of sunlight changes over the course of the year**. -Rotating a sphere about a tilted axis in front of a fixed light source can begin to demonstrate the effect of the tilt on daylight hours. If this demonstration is carried out at four different positions (90-degree progressions through a circle relative to the first position), it is possible to track and record the differences in the amount of time that a position on the earth receives sunlight based on the location of the sphere relative to the light source. -This same activity can be carried out as an investigation where students record the percentage of the ball that would be illuminated at varying positions throughout a "year" on the model.	**Macmillan/McGraw-Hill** **Discovery Education** -More Science Please: Earth Doesn't Sit Still, Why Should You? **IXL** -What Causes the Seasons on Earth? **Additional Sites** Reasons for the Seasons Why do we have seasons? **Britannica** -Science Launch Pack- Earth's Seasons -Science Launch Pack- Space Science: The Earth, Moon, and Sun -Earth's Tilt	**Crosscutting Concept:** **Systems and System Models** Students group and describe interactions of the components that define a larger system. **SCIENCE AND ENGINEERING PRINCIPLE:** **Planning and carrying out controlled investigations** Students carry out investigations in groups, where conditions and variables are controlled, utilize appropriate instruments, and deliberately plan multiple trials.
5.ESS1.6 Use tools and describe how stars and constellations appear to move from the Earth's perspective throughout the seasons. **COMPONENT IDEA:** **B.** Earth and the Solar System *same as 5.ESS1.3	-**Constellations are arrangements of stars in the sky**. -**Planets are also visible in the evening sky and can be differentiated from stars based on their appearance to the naked eye**. -**Positions of constellations and planets vary throughout the year as the relative position of the sun, earth, and distant stars change in the night sky**. -Tools such as **star charts** can be used to track and predict the location of constellations at various times during the year. -Throughout history, the location of some **constellations and stars have been used in navigation**. -**Telescopes**	**Macmillan/McGraw-Hill** Chapter 3 Lesson 3, specifically pages 176-182 **Discovery Education** -Stars and Galaxies -The Telescope **Additional Sites** Tonight's Sky Night Sky, This Month Astronomy- Tonight's Sky **Britannica** -Science Launch Pack- Space Science: Stars, Galaxies, and the Universe	**Crosscutting Concept:** **Pattern** Students recognize, classify, and record patterns involving rates of change. **SCIENCE AND ENGINEERING PRINCIPLE:** **Asking questions (for science) and defining problems (for engineering)** Questions generated by students are still based on experience, and begin to incorporate relationships between two things.
1 week- History and Composition of Earth			

5.ESS1.7 Use evidence from the presence and location of fossils to determine the order in which rock strata were formed. **COMPONENT IDEA:** **C.** The History of Planet Earth **See page 177 of the Framework, below** **C. How do people reconstruct and date events in Earth's planetary history?** Earth scientists use the structure, sequence, and properties of rocks, sediments, and fossils, as well as the locations of current and past ocean basins, lakes, and rivers, to reconstruct events in Earth's planetary history. For example, rock layers show the sequence of geological events, and the presence and amount of radioactive elements in rocks make it possible to determine their ages. Analyses of rock formations and the fossil record are used to establish relative ages. In an undisturbed column of rock, the youngest rocks are at the top, and the oldest are at the bottom. Rock layers have sometimes been rearranged by tectonic forces; rearrangements can be seen or inferred, such as from inverted sequences of fossil types. Core samples obtained from drilling reveal that the continents' rocks (some as old as 4 billion years or more) are much older than rocks on the ocean floor (less than 200 million years), where tectonic processes continually generate new rocks and destroy old ones. The rock record reveals that events on Earth can be catastrophic, occurring over hours to years, or gradual, occurring over thousands to millions of years. Records of fossils and other rocks also show past periods of massive extinctions and extensive volcanic activity. Although active geological processes, such as plate tectonics (link to ESS2.B) and erosion, have destroyed or altered most of the very early rock record on Earth, some other objects in the solar system, such as asteroids and meteorites, have changed little over billions of years. Studying these objects can help scientists deduce the solar system's age and history, including the formation of planet Earth. Study of other planets and their moons, many of which exhibit such features as volcanism and meteor impacts similar to those found on Earth, also help illuminate aspects of Earth's history and changes. The geological time scale organizes Earth's history into the increasingly long time intervals of eras, periods, and epochs. Major historical events include the formation of mountain chains and ocean basins, volcanic activity, the evolution and extinction of living organisms, periods of massive glaciation, and development of watersheds and rivers. Because many individual plant and animal species existed during known time periods (e.g., dinosaurs), the location of certain types of fossils in the rock record can reveal the age of the rocks and help geologists decipher the history of landforms.	-This particular standard concludes and provides evidence for ideas that were developed in fourth grade. -The processes that result in **the production of either fossils or sedimentary rock are very slow processes, requiring incredibly large periods of time to complete**. -Since these processes are well understood after fourth grade, revisiting this discussion along with discussions of space and the solar system allow for inferences that the **Earth's formation must have occurred long ago**. -In 8.PS2.4, this topic will be revisited as students gather evidence supporting **tectonic theory**. (It may be appropriate to link instruction of this standard to instruction of 5LS4.) **See page 178 of the Framework, below** **By the end of grade 5.** Earth has changed over time. Understanding how land- forms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help infer the history of the current landscape. Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. Patterns of tree rings and ice cores from glaciers can help reconstruct Earth's recent climate history.	**Macmillan/McGraw-Hill** Chapter 2 Lesson 4, specifically pages 130-131 Chapter 4 Lesson 1, specifically pages 194-201 **Discovery Education** -No Bones about It Lab -Plate Tectonics in Action -Earth Science: The Basics: Grades 03-05 **IXL** -Compare ages of fossils in a rock sequence -Label Earth features at tectonic plate boundaries -Describe tectonic plate boundaries around the world **Britannica** -Science Launch Pack- Fossils -Science Launch Pack- Rock Layers -Science Launch Pack- Earth Science: Earth's Past -Rock Cycle: Formation of Sedimentary Rock *5.LS4.1- look back at these resources also	**Crosscutting Concept:** **Scale, Proportion, and Quantity** Students become familiar with sizes immensely large or small or durations extremely short or long. **SCIENCE AND ENGINEERING PRINCIPLE:** **Analyzing and interpreting data.** Students should organize data (observations and measurements) in a manner which facilitates further analysis and comparisons.

Vocabulary: revolution, rotation, star, nebula, white dwarf, supernova, constellation, star chart, moons, asteroids, comets, meteoroids, spiral, elliptical, lenticular, solar eclipse, lunar eclipse, penumbra, umbra, waxing, waning, gibbous, crescent	
Inquiry Skills: predict, record data, observe, infer, communicate, classify, make a model, compare, draw conclusions	
Other Student Activities	**Planets and Stars** Calculate the age of the students on the various planets based on the number of earth days it takes to revolve around the sun. Calculate the weight of students on each planet.
Other Sites	**Britannica- Username:** Bartlett **Password:** gopanther1 Science Launch Packs https://solarsystem.nasa.gov https://www.esa.int/esaKIDSen/index.html https://kids.nationalgeographic.com/explore/space/passport-to-space/ http://www.ouruniverseforkids.com http://www.cosmos4kids.com/index.html http://stellarium.org

Guiding Question: What are the relationships among science, engineering, and technology? How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?

Engineering, Technology, and Applications of Science 3rd Nine Weeks- Links Among Engineering, Technology, Science, and Society (1 week)			
DCI: 5.ETS2: Links Among Engineering, Technology, Science, and Society			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.ETS2.2 Describe how human beings have made tools and machines (X-ray cameras, microscopes, satellites, computers) to observe and do things that they could not otherwise sense or do at all, or as quickly or efficiently. **COMPONENT IDEA:** **A.** Interdependence of Science, Technology, Engineering, and Math **See page 210 of the Framework, below** **A. What are the relationships among science, engineering, and technology**? The fields of science and engineering are mutually supportive, and scientists and engineers often work together in teams, especially in	-Scientific understanding develops as scientists are able to observe and explain things in the natural world. -**Technology has enabled scientists to extend their senses through the use of tools**. -These tools allow data storage, complex mathematical models, and increased capacity to see smaller and smaller details. **See page 211 of the Framework, below** ***By the end of grade 5.*** *Tools* and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about the natural world. Engineering design can develop and improve such technologies. Scientific discoveries about the natural world	**Macmillan/McGraw-Hill** Technology Lesson 3, page 380 Technology Lesson 4, page 388 **Discovery Education** **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Scale, Proportion, and Quantity** Students become familiar with sizes immensely large or small or durations extremely short or long. **SCIENCE AND ENGINEERING PRINCIPLE:** **Constructing explanations and designing solutions** Students can create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations.

fields at the borders of science and engineering. Advances in science offer new capabilities, new materials, or new under-standing of processes that can be applied through engineering to produce advances in technology. Advances in technology, in turn, provide scientists with new capabilities to probe the natural world at larger or smaller scales; to record, manage, and analyze data; and to model ever more complex systems with greater precision. In addition, engineers' efforts to develop or improve technologies often raise new questions for scientists' investigation.	can often lead to new and improved technologies, which are developed through the engineering design process. Knowledge of relevant scientific concepts and research findings is important in engineering.		
5.ETS2.3 Identity how scientific discoveries lead to new and improved technologies. **COMPONENT IDEA:** **B.** Influence of Engineering, Technology, and Science on Society and the Natural World **See page 212 of the Framework, below** **B. How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?** From the earliest forms of agriculture to the latest technologies, all human activity has drawn on natural resources and has had both short- and long-term consequences, positive as well as negative, for the health of both people and the natural environment. These consequences have grown stronger in recent human history. Society has changed dramatically, and human populations and longevity have increased, as advances in science and engineering have influenced the ways in which people interact with one another and with their surrounding natural environment. Science and engineering affect diverse domains—agriculture, medicine, housing, transportation, energy production, water availability, and land use, among others. The results often entail deep impacts on society and the environment, including some that may not have been anticipated when they were introduced or that may build up over time to levels that require attention. Decisions about the use of any new technology thus involve a balancing of costs, benefits, and risks— aided, at times, by science and engineering. Mathematical modeling, for example, can help provide insight into the consequences of actions beyond the scale of place, time, or system complexity that individual human judgments can readily encompass, thereby informing both personal and societal decision making. Not only do science and engineering affect society, but society's decisions (whether made through market forces or political processes) influence the work of scientists and engineers. These decisions sometimes establish goals and priorities for improving or replacing technologies; at other times they set limits, such as in regulating the extraction of raw materials or in setting allowable levels of pollution from mining, farming, and industry.	-The processes of scientific discovery and technological evolution are symbiotic. -Scientific understanding allows engineers to design systems differently and utilize materials to their fullest extent. -This perpetuates the creation of new devices that are more efficient or powerful than previous versions. The new devices open new research opportunities and permit further scientific understanding. This cycle is perpetual. -Examples may include taking a current piece of technology, viewing how the invention has developed through the years, and making predictions on how that technology might improve: (e.g., telegraph, telephone, and cell phone). **See page 213 of the Framework, below** **By the end of grade 5.** Over time, people's needs and wants change, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), to decrease known risks (e.g., seatbelts in cars), and to meet societal demands (e.g., cell phones). When new technologies become available, they can bring about changes in the way people live and interact with one another.	**Macmillan/McGraw-Hill** **Discovery Education** **Britannica** Science Launch Pack: Robotics Science Launch Pack: The Lightbulb Science Launch Pack: STEM	**Crosscutting Concept:** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students make and support claims about a proposed device or solution.

Guiding Questions: How can matter be described? How do particles combine to form the variety of matter one observes? How are the physical and chemical properties of matter different? How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them? What factors influence how matter moves?

Physical Science	**3rd Nine Weeks- Matter and Its Interactions (4 weeks)**		
DCI: 5.PS1: Matter and Its Interactions			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.PS1.1 Analyze and interpret data from observations and measurements of the physical properties of matter to explain phase changes between a solid, liquid, or gas.	-The **purpose of this standard is not to emphasize phases of matter**. That topic is covered extensively in third grade. -Instead, the focus should be on **phase changes for materials and the associate physical properties of boiling point and melting point** to prepare students to address intermolecular	**Macmillan/McGraw-Hill** Chapter 5 Lesson 2, page 270 Chapter 5 Lesson 3, page 282 **Discovery Education** -Real World Science: Matter: Solids, Liquids, and Gases	**Crosscutting Concept:** **Structure and Function** Students begin to recognize that objects have smaller substructures which determine the property of a material or system.

COMPONENT IDEA: **A.** Structure and Properties of Matter **See page 106 of the Framework, below** **A. How do particles combine to form the variety of matter one observes?** While too small to be seen with visible light, atoms have substructures of their own. They have a small central region or nucleus—containing protons and neutrons—surrounded by a larger region containing electrons. The number of pro- tons in the atomic nucleus (atomic number) is the defining characteristic of each element; different isotopes of the same element differ in the number of neutrons only. Despite the immense variation and number of substances, there are only some 100 different stable elements. Each element has characteristic chemical properties. The periodic table, a systematic representation of known elements, is organized horizontally by increasing atomic number and vertically by families of elements with related chemical properties. The development of the periodic table (which occurred well before atomic substructure was understood) was a major advance, as its patterns suggested and led to the identification of additional elements with particular properties. Moreover, the table's patterns are now recognized as related to the atom's outermost electron patterns, which play an important role in explaining chemical reactivity and bond formation, and the periodic table continues to be a useful way to organize this information. The substructure of atoms determines how they combine and rearrange to form all of the world's substances. Electrical attractions and repulsions between charged particles (i.e., atomic nuclei and electrons) in matter explain the structure of atoms and the forces between atoms that cause them to form molecules (via chemical bonds), which range in size from two to thousands of atoms (e.g., in biological molecules such as proteins). Atoms also combine due to these forces to form extended structures, such as crystals or metals. The varied properties (e.g., hardness, conductivity) of the materials one encounters, both natural and manufactured, can be understood in terms of the atomic and molecular constituents present and the forces within and between them. Within matter, atoms and their constituents are constantly in motion. The arrangement and motion of atoms vary in characteristic ways, depending on the sub- stance and its current state (e.g., solid, liquid). Chemical composition, temperature, and pressure affect such arrangements and motions of atoms, as well as the ways in which they interact. Under a given set of conditions, the state and some properties (e.g., density, elasticity, viscosity) are the same for different bulk quantities of a substance, whereas other properties (e.g., volume, mass) provide measures of the size of the sample at hand. Materials can be characterized by their intensive measureable properties. Different materials with different properties are suited to different uses. The ability to image and manipulate placement of individual atoms in tiny structures allows for the design of new types of materials with particular desired functionality (e.g., plastics, nanoparticles). Moreover, the modern explanation of how particular atoms influence the properties of materials or molecules is critical to understanding the physical and chemical functioning of biological systems.	attractions in later grades. -Students should make observations and collect data that the **temperature of ice water will remain (near) zero degrees Celsius until all the ice has melted**. -**Water will have a characteristic boiling point of one hundred degrees Celsius**. -Building understanding of these physical properties will allow students to use them as criteria in 5.PS1.4. (<u>Phase change diagrams such a heating and cooling curves are beyond the scope of this standard</u>.) **See page 108 of the Framework, below** **By the end of grade 5.** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means (e.g., by weighing or by its effects on other objects). For example, a model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (e.g., sugar in solution, evaporation in a closed container). Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	-TLC Elementary School: Introduction to Physical Science -Changing States Lab **<u>IXL</u>** -Change of State Diagram -Heating, Cooling, and the Changes of State **<u>Britannica</u>** -Science Launch Pack- The States of Matter -Science Launch Pack- Physical Science: Matter -Phase Changes -Properties of matter: density	**<u>SCIENCE AND ENGINEERING PRINCIPLE:</u>** **Analyzing and interpreting data.** Students should organize data (observations and measurements) in a manner which facilitates further analysis and comparisons.
5.PS1.2 Analyze and interpret data to show that the amount of matter is conserved even when it changes form, including transitions where matter seems to vanish.	-Instances where matter appears to vanish might include dissolving salt or sugar into water or dropping antacid tablets into a glass of water, producing gas. -Students can make measure the masses of these systems before and after combining to provide evidence for the law of	**<u>Macmillan/McGraw-Hill</u>** Explore on page 283 **<u>Activity</u>** 5.PS1.2 Analyzing and Interpreting Data Activity	**<u>Crosscutting Concept:</u>** **Energy and Matter** Students track transformations of matter to demonstrate the law of conservation of mass. **<u>SCIENCE AND ENGINEERING PRINCIPLE:</u>**

COMPONENT IDEA: **A.** Structure and Properties of Matter *same as 5.PS1.1	conservation of mass even when particles seem to vanish. **Three-Dimensional Learning Performance for Lesson-** Students will analyze and interpret data* in order to show that matter is conserved even when it changes form**, highlighting that matter is conserved even in transitions where it seems to vanish.***	**Discovery Education** -Matter and Its Properties: Exploring Phases of Matter -Changing States: Assignment 3- Mass and Changing States **IXL** -Understand Conservation of Matter Using Graphs **Britannica** -Science Launch Pack- Energy Transformations -Science Launch Pack- Physical Science: Matter **Activity** -Changing Matter	**Analyzing and interpreting data.** Students organize data (observations and measurements) in a manner which facilitates further analysis and comparisons.
5.PS1.3 Design a process to measure how different variables (temperature, particle size, stirring) affect the rate of dissolving solids into liquids. **COMPONENT IDEA:** **B.** Chemical Processes **See page 109 of the Framework, below** **B. How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them?** Many substances react chemically with other substances to form new substances with different properties. This change in properties results from the ways in which atoms from the original substances are combined and rearranged in the new sub- stances. However, the total number of each type of atom is conserved (does not change) in any chemical process, and thus mass does not change either. The property of conservation can be used, along with knowledge of the chemical properties of particular elements, to describe and predict the outcomes of reactions. Changes in matter in which the molecules do not change, but their positions and their motion relative to each other do change also occur (e.g., the forming of a solution, a change of state). Such changes are generally easier to reverse (return to original conditions) than chemical changes. "Collision theory" provides a qualitative model for explaining the rates of chemical reactions. Higher rates occur at higher temperatures because atoms are typically moving faster and thus collisions are more frequent; also, a larger fraction of the collisions have sufficient energy to initiate the process. Although a solution or a gas may have constant chemical composition—that is, be in a steady state—chemical reactions may be occurring within it that are dynamically balanced with reactions in opposite directions proceeding at equal rates. Any chemical process involves a change in chemical bonds and the	-Students can create experiments to investigate the relationships between these variables. -Care should be taken to ensure that subsequent trails are comparable by using controls. -For example, if studying the effect of varying temperature on dissolving a solid, equal amounts of solid should be utilized. -This standard can be connected to 5.PS1.2 since the process of dissolving the solids might appear to cause matter to vanish. **See page 110 of the Framework, below** ***By the end of grade 5.*** When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	**Macmillan/McGraw-Hill** -same Explore on page 283 -Quick Lab on page 287 -Be a Scientist on pages 290-291, Activity Lab Book, page 117 **Discovery Education** **IXL** -Understand an experimental protocol about evaporation -Identify control and experimental groups -Identify independent and dependent variables **Britannica** -Science Launch Pack- Physical Science: Matter	**Crosscutting Concept:** **Stability and Change** Students begin to describe changes in terms of time over which they occur; their rate. **SCIENCE AND ENGINEERING PRINCIPLE:** **Planning and carrying out controlled investigations** Students carry out investigations in groups, where conditions and variables are controlled, utilize appropriate instruments, and deliberately plan multiple trials.

related bond energies and thus in the total chemical binding energy. This change is matched by a difference between the total kinetic energy of the set of reactant molecules before the collision and that of the set of product molecules after the collision (conservation of energy). Some reactions release energy (e.g., burning fuel in the presence of oxygen), and others require energy input (e.g., synthesis of sugars from carbon dioxide and water). Understanding chemical reactions and the properties of elements is essential not only to the physical sciences but also is foundational knowledge for the life sciences and the earth and space sciences. The cycling of matter and associated transfers of energy in systems, of any scale, depend on physical and chemical processes. The reactivity of hydrogen ions gives rise to many biological and geophysical phenomena. The capacity of carbon atoms to form the backbone of extended molecular structures is essential to the chemistry of life. The carbon cycle involves transfers between carbon in the atmosphere—in the form of carbon dioxide—and carbon in living matter or formerly living matter (including fossil fuels). The pro- portion of oxygen molecules (i.e., oxygen in the form O2) in the atmosphere also changes in this cycle.			
5.PS1.4 Evaluate the results of an experiment to determine whether the mixing of two or more substances result in a change of properties. **COMPONENT IDEA:** **B.** Chemical Processes *same as 5.PS1.3	-In standard 3.PS1.3 and 5.PS1.1, students build familiarity with **physical properties of substances that make each substance unique**. -When two materials are mixed, the result can be either a **"mixture" or a new compound**. -Students should use their knowledge of physical properties to **provide support for the argument that the mixing of substances created a new substance or resulted in a mixture that consists of the original substance**.	**Macmillan/McGraw-Hill** Chapter 5 Lesson 4, page 292 **Discovery Education** -Solutions -Investigating Mixtures, Solutions, Elements, and Compounds -Solutions at Work **IXL** -Identifying Mixtures -Compare Physical and Chemical Changes **Britannica** -Science Launch Pack- Physical Science: Matter -Science Launch Pack- Matter	**Crosscutting Concept:** **Cause and Effect** Students routinely search for cause and effect relationships in systems they study. **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students create and identify evidence- based arguments and consider whether an argument is supported by evidence or relies on opinions or incomplete representations of relevant evidence.

Guiding Questions: How can one predict an object's continued motion, changes in motion, or stability? Why are some physical systems more stable than others? What underlying forces explain the variety of interactions observed? How can matter be described? What causes matter to move? Can the shape of an object affect how gravity pulls on it?

Physical Science	3rd Nine Weeks- Motion and Stability: Forces and Interactions (4 weeks)		
DCI: 5.PS2: Motion and Stability: Forces and Interactions			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.PS2.1 Test the effects of balanced and unbalanced forces on the speed and direction of motion of objects. **COMPONENT IDEA:**	-Students have investigated forces acting on objects and the effects of multiple forces in second grade. -This standard begins to introduce students to the idea of **net force, the total of all forces that act on an object**. In eighth	**Macmillan/McGraw-Hill** Chapter 6 Lesson 2, specifically pages 326-332 **Activity**	**Crosscutting Concept:** **Stability and Change** Students begin to describe changes in terms of time over which they occur; their rate.

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A. Forces, Fields, and Motion

See page 114 of the Framework, below
A. How can one predict an object's continued motion, changes in motion, or stability?
Interactions of an object with another object can be explained and predicted using the concept of forces, which can cause a change in motion of one or both of the interacting objects. An individual force acts on one particular object and is described by its strength and direction. The strengths of forces can be measured and their values compared.
What happens when a force is applied to an object depends not only on that force but also on all the other forces acting on that object. A static object typically has multiple forces acting on it, but they sum to zero. If the total (vector sum) force on an object is not zero, however, its motion will change. Sometimes forces on an object can also change its shape or orientation. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first but in the opposite direction (Newton's third law).
At the macroscale, the motion of an object subject to forces is governed by Newton's second law of motion. Under everyday circumstances, the mathematical expression of this law in the form $F = ma$ (total force = mass times acceleration) accurately predicts changes in the motion of a single macroscopic object of a given mass due to the total force on it. But at speeds close to the speed of light, the second law is not applicable without modification. Nor does it apply to objects at the molecular, atomic, and subatomic scales, or to an object whose mass is changing at the same time as its speed.
For speeds that are small compared with the speed of light, the momentum of an object is defined as its mass times its velocity. For any system of interacting objects, the total momentum within the system changes only due to transfer of momentum into or out of the system, either because of external forces acting on the system or because of matter flows. Within an isolated system of interact- ing objects, any change in momentum of one object is balanced by an equal and oppositely directed change in the total momentum of the other objects. Thus total momentum is a conserved quantity.

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grade, students will combine this understanding of net force with an understanding of inertia (mass) to fully develop Newton's Second Law.

-At this point, **it is important that students are able to recognize that it is common to have multiple forces acting on any object simultaneously**.

-For instance: While standing still, the force of gravity pushes down on a person, while the surface of the Earth must push them upwards to keep the person from sinking down into the Earth's crust.

-Note: It is likely that scenarios may arise in which a force acts diagonally on an object (as opposed to sideways/or up and down). Such forces should be considered to act: partially in a direction parallel to the way that an object can possibly move, and partially in the direction perpendicular.

-Students should **consider the effects of both balanced forces which will not change the motion of an object, and unbalanced forces which do change the motion of an object**.

(<u>Students are not responsible for forces that act diagonally with respect to the direction an object will move or is moving. All forces will act in only one dimension, either parallel or perpendicular</u>.)

See page 115 of the Framework, below
By the end of grade 5. Each force acts on one particular object and has both a strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) The patterns of an object's motion in various situations can be observed and measured; when past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Three-Dimensional Learning Performance for Lesson-
Students will plan and carry out investigations* in order to show the effects of balanced and unbalanced forces on the speed and direction of motion on objects ** highlighting the stability and change in a system.**

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5.PS2.1 Planning and Carrying Out Controlled Investigations Activity

<u>**Discovery Education**</u>
-Unbalanced Forces
-Balanced Forces
-About Forces
-Real World Science: Forces

<u>**IXL**</u>
-Identify Direction of Forces
-How do balanced and unbalanced forces affect motion?

<u>**Britannica**</u>
Science Launch Pack- Physical Science: Motion and Forces
Science Launch Pack- Motion and Forces

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<u>**SCIENCE AND ENGINEERING PRINCIPLE:**</u>
Planning and carrying out controlled investigations
Students carry out investigations in groups, where conditions and variables are controlled, utilize appropriate instruments, and deliberately plan multiple trials.

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5.PS2.2 Make observations and measurements of an object's motion to provide evidence that pattern can be used to predict future motion. **COMPONENT IDEA:** **C.** Stability and Instability in Physical Systems **See page 118 of the Framework, below** **C. Why are some physical systems more stable than others?** Events and processes in a system typically involve multiple interactions occurring simultaneously or in sequence. The system's stability or instability and its rate of evolution depend on the balance or imbalance among these multiple effects. A stable system is one in which the internal and external forces are such that any small change results in forces that return the system to its prior state (e.g., a weight hanging from a string). A system can be static but unstable, with any small change leading to forces that tend to increase that change (e.g., a ball at the top of a hill). A system can be changing but have a stable repeating cycle of changes, with regular patterns of change that allow predictions about the system's future (e.g., Earth orbiting the sun). And a stable system can appear to be unchanging when flows or processes within it are going on at opposite but equal rates (e.g., water in a dam at a constant height but with water flowing in that offsets the water flowing out; a person maintaining steady weight but eating food, burning calories, and excreting waste). Stability and instability in any system depend on the balance of competing effects. A steady state of a complex system can be maintained through a set of feedback mechanisms, but changes in conditions can move the system out of its range of stability (e.g., homeostasis breaks down at too high or too low a temperature). With no energy inputs, a system starting out in an unstable state will continue to change until it reaches a stable configuration (e.g., the temperatures of hot and cold objects in contact). Viewed at a given scale, stable systems may appear static or dynamic. Conditions and properties of the objects within a system affect the rates of energy transfer and thus how fast or slowly a process occurs (e.g., heat conduction, the diffusion of particles in a fluid). When a system has a great number of component pieces, one may not be able to predict much about its precise future. For such systems (e.g., with very many colliding molecules), one can often predict average but not detailed properties and behaviors (e.g., average temperature, motion, and rates of chemical change but not the trajectories of particular molecules).	-The focus of this standard is to provide students with the opportunity to **observe motion that occurs in cycles** and use an understanding of these cycles to make future predictions. -This type of motion is called **simple harmonic motion**. -Examples might include any variety of pendulum, a see-saw or objects traveling circular paths such as a carousel. (Instruction should **focus on the forces required to create periodic motion and how these forces change**, but not emphasize technical terms such as period.) **See page 119 of the Framework, below** ***By the end of grade 5.*** A system can change as it moves in one direction (e.g., a ball rolling down a hill), shifts back and forth (e.g., a swinging pendulum), or goes through cyclical patterns (e.g., day and night). Examining how the forces on and within the system change as it moves can help to explain the system's patterns of change. A system can appear to be unchanging when processes within the system are occurring at opposite but equal rates (e.g., water behind a dam is at a constant height because water is flowing in at the same rate that water is flowing out). Changes can happen very quickly or very slowly and are sometimes hard to see (e.g., plant growth). Conditions and properties of the objects within a system affect how fast or slowly a process occurs (e.g., heat conduction rates). **Three-Dimensional Learning Performance for Lesson-** Students will make observations and measurements of a pendulum* in order to show that graphs of an object's motion can be used as evidence to predict future motion** highlighting the patterns seen when changing specific variables of the pendulum.***	**Macmillan/McGraw-Hill** **Activity** 5.PS2.2 Using Mathematics and Computational Thinking Activity **Discovery Education** -Motion -Laws of Motion **IXL** -How does mass affect force and acceleration? **Britannica** Science Launch Pack- Motion Science Launch Pack- Physical Science: Motion and Forces Science Launch Pack- Motion and Forces	**Crosscutting Concept:** **Pattern** Students recognize, classify, and record patterns involving rates of change. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.
5.PS2.3 Use evidence to support that the gravitational force exerted by Earth on objects is directed toward the Earth's center. **COMPONENT IDEA:** **A.** Forces, Fields, and Motion *same as 5.PS2.1	-Evidence may include personal experience. It is not likely that a student has been to a wide variety of places on Earth, so further discussions may be required. -To compensate for this, students might consider that **a ball dropped anywhere on Earth will fall towards Earth's surface.** A model could be constructed based on such discussions, wherein all objects are falling towards Earth's center.	**Macmillan/McGraw-Hill** Chapter 6 Lesson 2, specifically pages 324-325 **Discovery Education** -Gravity **Britannica** Science Launch Pack- Gravity Science Launch Pack- Motion and Forces	**Crosscutting Concept:** **Cause and Effect** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Developing and using models** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.

5.PS2.4 Explain the cause and effect relationship between two factors (mass and distance) that affect gravity. **COMPONENT IDEA:** **B.** Types of Interactions **See page 116 of the Framework, below** **B. What underlying forces explain the variety of interactions observed?** All forces between objects arise from a few types of interactions: gravity, electro- magnetism, and strong and weak nuclear interactions. Collisions between objects involve forces between them that can change their motion. Any two objects in contact also exert forces on each other that are electromagnetic in origin. These forces result from deformations of the objects' substructures and the electric charges of the particles that form those substructures (e.g., a table supporting a book, friction forces). Gravitational, electric, and magnetic forces between a pair of objects do not require that they be in contact. These forces are explained by force fields that contain energy and can transfer energy through space. These fields can be mapped by their effect on a test object (mass, charge, or magnet, respectively). Objects with mass are sources of gravitational fields and are affected by the gravitational fields of all other objects with mass. Gravitational forces are always attractive. For two human-scale objects, these forces are too small to observe without sensitive instrumentation. Gravitational interactions are nonnegligible, however, when very massive objects are involved. Thus the gravitational force due to Earth, acting on an object near Earth's surface, pulls that object toward the planet's center. Newton's law of universal gravitation provides the mathematical model to describe and predict the effects of gravitational forces between distant objects. These long-range gravitational interactions govern the evolution and maintenance of large-scale structures in the universe (e.g., the solar system, galaxies) and the patterns of motion within them. Electric forces and magnetic forces are different aspects of a single electro- magnetic interaction. Such forces can be attractive or repulsive, depending on the relative sign of the electric charges involved, the direction of current flow, and the orientation of magnets. The forces' magnitudes depend on the magnitudes of the charges, currents, and magnetic strengths as well as on the distances between the interacting objects. All objects with electrical charge or magnetization are sources of electric or magnetic fields and can be affected by the electric or magnetic fields of other such objects. Attraction and repulsion of electric charges at the atomic scale explain the structure, properties, and transformations of matter and the contact forces between material objects (link to PS1.A and PS1.B). Coulomb's law provides the mathematical model to describe and predict the effects of electrostatic forces (relating to stationary electric charges or fields) between distant objects. The strong and weak nuclear interactions are important inside atomic nuclei. These short-range interactions determine nuclear sizes, stability, and rates of radioactive decay (see PS1.C).	-An understanding of this concept should provide students a way to reconcile that **all objects fall downwards the same rate**. -In second grade, students observed that larger (more massive) objects are harder to move. Building on this observation, it follows that **gravity must exert a larger force if large objects, which are harder to move, fall at the same rate as smaller objects which are easier to move**. -Examples of the effect of distance on gravity might include that astronauts eventually experience weightlessness as they get further from the surface of the earth. (Care should be taken when addressing gravity on the moon vs Earth as an example, because there are differences in both mass and distance (radius), so identifying a single cause for the changes to gravity cannot be attributed exclusively to mass or distance.) **See page 117 of the Framework, below** **By the end of grade 5.** Objects in contact exert forces on each other (friction, elastic pushes and pulls). Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact—for example, magnets push or pull at a distance. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**Macmillan/McGraw-Hill** Chapter 6 Lesson 2, specifically page 325 **Discovery Education** -Laws of Universal Gravitation **Britannica** Science Launch Pack- Forces Science Launch Pack- Gravity Science Launch Pack- Motion and Forces	**Crosscutting Concept:** **Cause and Effect** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students create and identify evidence- based arguments and consider whether an argument is supported by evidence or relies on opinions or incomplete representations of relevant evidence.

5.PS2.5 Explain how forces can create patterns within a system (moving in one direction, shifting back and forth, or moving in cycles), and describe conditions that affect how fast or slowly these patterns occur. **COMPONENT IDEA:** **C.** Stability and Instability in Physical Systems *same as 5.PS2.2	-This standard provides elaboration on 5.PS2.2. **Once patterns are observed in the motion of an object, students should begin to explore the underlying causes for this motion.** -Examples of moving in one direction might include objects in freefall, accelerated by gravity. -Objects moving back and forth could include a mass bobbing up and down at the end of a stretched spring. Objects moving in cycles could include a yo-yo while performing the "around the world" trick. -Planets orbiting the sun are also examples of moving in cycles, but students understanding the invisible force of gravity may not be possible. The tension force exerted by a yo-yo string is more tangible than gravity.	**Macmillan/McGraw-Hill** Chapter 6 Lesson 3, page 336 **Discovery Education** **Britannica** Science Launch Pack- Physical Science: Motion and Forces Science Launch Pack- Motion and Forces	**Crosscutting Concept:** **Pattern** *Elaboration on CCC* **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students create and identify evidence- based arguments and consider whether an argument is supported by evidence or relies on opinions or incomplete representations of relevant evidence.

Third Nine Weeks Resources	
Vocabulary: physical property, chemical property, condensation, evaporation, mass, weight, volume, density, buoyancy, conductor, mixture, solution, position, simple harmonic motion, motion frame of reference, speed, velocity, acceleration, momentum, gravity, friction, balanced force, action force, reaction force, unbalanced	
Inquiry Skills: predict, record data, observe, infer, classify, compare, draw conclusions	
Other Student Activities	**Matter Changes** Compare the crystals from a variety of salts such as alum, citric acid, and Epsom salt **Changes of State** Design an investigation to classify various substances based on their rate of freezing, melting, or evaporating. **Motion and Forces** Write and evaluate the expressions related to speed of tsunami, jet stream, tornado, jet plane etc. Find out the cost of operating a passenger plane based on the number of passengers and the time of a flight.
Other Sites	**Britannica- Username:** Bartlett **Password:** gopanther1 Science Launch Packs

Department of Teaching & Learning
Fifth Grade Science Curriculum Guide

Guiding Question: What is the process for developing potential design solutions? What are the relationships among science, engineering, and technology? How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world? What tools, skills, knowledge, and dispositions are needed to construct a bridge?

Engineering, Technology, and Applications of Science 4th Nine Weeks- Engineering Design (9 weeks)			
DCI: 5.ETS1: Engineering Design			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
-Describe how tools, technology, and inventions help to answer questions and solve problems. -Recognize that new tools, technology, and inventions -Identify appropriate materials, tools, and machines that can extend or enhance the ability to solve a specified problem. -Recognize the connection between scientific advances, new knowledge, and the availability of new tools and technologies. -Apply a creative design strategy to solve a particular problem generated by societal needs. -Explore different scientific phenomena by asking questions, making logical predictions, planning investigations, and recording data. -Select and use appropriate tools and simple equipment to conduct an investigation. -Organize data into appropriate tables, graphs, drawings, or diagrams. -Identify and interpret simple patterns of evidence to communicate the finding of multiple investigations. -Recognize that people may interpret the same results in different ways	Create a structured bridge that can be tested in theory and relativity. Analyze and communicate findings from multiple investigations of similar phenomena to reach a conclusion. Apply a creative design strategy to solve a particular problem generated by societal the needs and wants. Use a two coordinate graph display to show the relationship between variables in an investigation. Analyze data to develop a conclusion and extend a graph to make predictions. Compare results of an investigation with others and interpret the results. Describe technologies or inventions that could be used to determine these relationships. Develop a system to demonstrate how the relationship between mass, force, and distance traveled works within that system. Create a chart and provide examples of when forces act at a distance.	**Macmillan/McGraw-Hill** Chapter 6, Lesson 1 p. 308 Chapter 6, Lesson 2 p. 322 Building Bridges	1.Asking questions and defining problems 2.Developing and using models 3.Planning and carrying out investigation 4.Analyzing and Interpreting Data 5.Using Mathematics and Computational Thinking 6. Constructing Explanations and Designing Solutions 7. Engaging in argument from evidence 8. Obtaining, Evaluating, and Communicating Information **Mathematics** Use variables appropriately to represent numbers whose values are not yet known. Make, record, display and interpret data and graphs that include whole numbers, decimals, and fractions. Make conjectures about geometric properties and develop logical arguments to justify conclusions. Design investigations to address a question and consider how data collection methods affect the nature of the data set. **Literacy** Organize information from text or technological sources using a graphic organizer. Predict outcomes and adjust as additional information is acquired. Build vocabulary by reading from a wide variety of texts and literary genres. Write for a variety of purposes and to a variety of audiences. Use current technology as a research and communication tool for personal interest, research, and clarification.

5.ETS1.1 Research, test, re- test, and communicate a design to solve a problem. **COMPONENT IDEA:** **B.** Developing Possible Solutions **See page 206 of the Framework, below** **B. What is the process for developing potential design solutions?** The creative process of developing a new design to solve a problem is a central element of engineering. This process may begin with a relatively open-ended phase during which new ideas are generated both by individuals and by group processes such as brainstorming. Before long, the process must move to the specification of solutions that meet the criteria and constraints at hand. Initial ideas may be communicated through informal sketches or diagrams, although they typically become more formalized through models. The ability to build and use physical, graphical, and mathematical models is an essential part of translating a design idea into a finished product, such as a machine, building, or any other working system. Because each area of engineering focuses on particular types of systems (e.g., mechanical, electrical, biotechnological), engineers become expert in the elements that such systems need. But whatever their fields, all engineers use models to help develop and communicate solutions to design problems. Models allow the designer to better understand the features of a design problem, visualize elements of a possible solution, predict a design's performance, and guide the development of feasible solutions (or, if possible, the optimal solution). A physical model can be manipulated and tested for parameters of interest, such as strength, flexibility, heat conduction, fit with other components, and durability. Scale models and prototypes are particular types of physical models. Graphical models, such as sketches and drawings, permit engineers to easily share and discuss design ideas and to rapidly revise their thinking based on input from others. Mathematical models allow engineers to estimate the effects of a change in one feature of the design (e.g., material composition, ambient temperature) on other features, or on performance as a whole, before the designed product is actually built. Mathematical models are often embedded in computer-based simulations. Computer-aided design (CAD) and computer-aided manufacturing (CAM) are modeling tools commonly used in engineering. Data from models and experiments can be analyzed to make decisions about modifying a design. The analysis may reveal performance information, such as which criteria a design meets, or predict how well the overall designed system or system component will behave under certain conditions. If analysis reveals that the predicted performance does not align with desired criteria, the design can be adjusted.	-In order to effectively design a solution for a given problem, it is **imperative that engineers become experts in the relevant fields**. -Students can **use a deliberately crafted problem as a focal point for the design of a solution to the problem**. -**Research driven by the need to solve a problem may provide a way for students to explore new concepts/phenomena**. -**Communication may involve brainstorming possible solutions as well as presenting the results of the designed tests**. -Examples may include using a real-world problem, such as the effects of Hurricane Katrina or Harvey, and having students design solutions using constraints such as time, materials, and space. Other examples may include solutions to areas in a flood zone: dams holding water back, reservoirs storing flood water, levees and embankments preventing overflow, and channel straightening increasing speed of flow. **See page 207 of the Framework, below** ***By the end of grade 5.*** *Research on a problem should be carried out for example, through Internet searches, market research, or field observations—before beginning to design a solution. An often productive way to generate ideas is for people to work together to brainstorm, test, and refine possible solutions. Testing a solution involves investigating how well it performs under a range of likely conditions. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.* *There are many types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs.*	**Macmillan/McGraw-Hill** Technology Lesson 2, page 372 **Discovery Education** -Student Engineering Design Sheet -Engineering Lab: Material Tool **IXL** -Identify parts of the engineering-design process -Evaluate tests of engineering-design solutions **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Obtaining, evaluating, and communicating information** Students can communicate technical information about proposed design solutions using tables, graphs, and diagrams.

5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype. **<u>COMPONENT IDEA:</u>** **B.** Developing Possible Solutions *same as 5.ETS1.1	-**Engineered objects are methodically tested before production**. -**Tests are designed to stress certain components** to determine the extremes to which a given component will remain functional. -Student-developed tests should move beyond simply making a device and "trying it out" and should have tests designed to cause failure into a specified component a biomedical engineering example may include creating a prosthetic hand piece using materials such as tape, spoon, paperclips, and foam pieces. -Then, **test the prototype, evaluate, make modifications, and retest**.	**<u>Macmillan/McGraw-Hill</u>** Technology Lesson 2, page 372 **<u>Discovery Education</u>** -<u>Greatest Inventions with Bill Nye: Engineering and Architecture</u> -<u>Picture This: Using Diagrams</u> **<u>Britannica</u>** <u>Science Launch Pack: STEM</u>	**<u>Crosscutting Concept:</u>** **Cause and Effect** Students identify conditions required for specific cause and effect interactions to occur through investigation. **<u>SCIENCE AND ENGINEERING PRINCIPLE:</u>** **Developing and using models** Students can identify specific limitations of their models.
5.ETS1.3 Describe how failure provides valuable information toward finding a solution. **<u>COMPONENT IDEA:</u>** **B.** Developing Possible Solutions *same as 5.ETS1.1	-**Failure is essential to both science and engineering**. Without failure it is not possible to understand the limitations or shortcomings of a device or explanation. Students should be encouraged to embrace productive failure as part of the design process to encourage persistent exploration. Scientific discussions might include now revised theories such as vis viva.	**<u>Macmillan/McGraw-Hill</u>** **<u>Discovery Education</u>** **<u>Britannica</u>** <u>Science Launch Pack: STEM</u>	**<u>Crosscutting Concept:</u>** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. ***<u>SCIENCE AND ENGINEERING PRINCIPLE:</u>*** **Engaging in argument from evidence** Students make and support claims about a proposed device or solution.

Engineering, Technology, and Applications of Science 4th Nine Weeks- Links Among Engineering, Technology, Science, and Society			
DCI: 5.ETS2: Links Among Engineering, Technology, Science, and Society			
TN State Standards	**Objectives/Learning Targets (Explanation)**	**Instructional Resources**	**Cross Cutting Concepts and Science and Engineering Principles**
5.ETS2.1 Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology. **<u>COMPONENT IDEA:</u>** **A.** Interdependence of Science, Technology, Engineering, and Math **See page 210 of the Framework, below** **A. What are the relationships among science, engineering, and technology***?* The fields of science and engineering are mutually supportive, and scientists and engineers often work together in teams, especially in fields at the borders of science and engineering. Advances in science offer new capabilities, new materials, or new under-standing of processes that can be applied through engineering to produce advances in technology. Advances in technology, in turn,	-Using tools allows students to acquire two important engineering skills. -Students can gain an **understanding of how tools have enabled humans to build**. -Students acquire **the ability to produce actual prototypes as part of the engineering process**. This skill allows for development of more involved tests of components of a design. **See page 211 of the Framework, below** ***By the end of grade 5.*** *Tools* and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about the natural world. Engineering design can develop and improve such technologies. Scientific discoveries about the natural world	**<u>Macmillan/McGraw-Hill</u>** Reference R2-9 **<u>Discovery Education</u>** **<u>Britannica</u>** <u>Science Launch Pack: STEM</u>	**<u>Crosscutting Concept:</u>** **Structure and Function** Students begin to attribute the shapes of sub-components to the function of the part. **<u>SCIENCE AND ENGINEERING PRINCIPLE:</u>** **Developing and using models** Students can create a design plan or prototype of a tool or object which incorporates cause and effect behaviors within the device.

provide scientists with new capabilities to probe the natural world at larger or smaller scales; to record, manage, and analyze data; and to model ever more complex systems with greater precision. In addition, engineers' efforts to develop or improve technologies often raise new questions for scientists' investigation.	can often lead to new and improved technologies, which are developed through the engineering design process. Knowledge of relevant scientific concepts and research findings is important in engineering.		
5.ETS2.2 Describe how human beings have made tools and machines (X-ray cameras, microscopes, satellites, computers) to observe and do things that they could not otherwise sense or do at all, or as quickly or efficiently. **COMPONENT IDEA:** **A.** Interdependence of Science, Technology, Engineering, and Math *same as 5.ETS2.1	-Scientific understanding develops as scientists are able to observe and explain things in the natural world. -**Technology has enabled scientists to extend their senses through the use of tools**. -These tools allow data storage, complex mathematical models, and increased capacity to see smaller and smaller details.	**Macmillan/McGraw-Hill** Technology Lesson 3, page 380 Technology Lesson 4, page 388 **Discovery Education** **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Scale, Proportion, and Quantity** Students become familiar with sizes immensely large or small or durations extremely short or long. **SCIENCE AND ENGINEERING PRINCIPLE:** **Constructing explanations and designing solutions** Students can create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations.
5.ETS2.3 Identity how scientific discoveries lead to new and improved technologies. **COMPONENT IDEA:** **B.** Influence of Engineering, Technology, and Science on Society and the Natural World **See page 212 of the Framework, below** **B. How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?** From the earliest forms of agriculture to the latest technologies, all human activity has drawn on natural resources and has had both short- and long-term consequences, positive as well as negative, for the health of both people and the natural environment. These consequences have grown stronger in recent human history. Society has changed dramatically, and human populations and longevity have increased, as advances in science and engineering have influenced the ways in which people interact with one another and with their surrounding natural environment. Science and engineering affect diverse domains—agriculture, medicine, housing, transportation, energy production, water availability, and land use, among others. The results often entail deep impacts on society and the environment, including some that may not have been anticipated when they were introduced or that may build up over time to levels that require attention. Decisions about the use of any new technology thus involve a balancing of costs, benefits, and risks— aided, at times, by science and engineering. Mathematical modeling, for example, can help provide insight into the consequences of actions beyond the scale of place, time, or system complexity that individual human judgments can readily encompass, thereby informing both personal and societal decision making. Not only do science and engineering affect society, but society's decisions (whether made through market forces or political processes) influence the work of scientists and engineers. These decisions sometimes establish goals and priorities for improving or replacing technologies; at other times they set limits, such as in regulating the extraction of raw materials or in setting allowable levels of pollution from mining, farming, and	-The processes of scientific discovery and technological evolution are symbiotic. -Scientific understanding allows engineers to design systems differently and utilize materials to their fullest extent. -This perpetuates the creation of new devices that are more efficient or powerful than previous versions. The new devices open new research opportunities and permit further scientific understanding. This cycle is perpetual. -Examples may include taking a current piece of technology, viewing how the invention has developed through the years, and making predictions on how that technology might improve: (e.g., telegraph, telephone, and cell phone). **See page 213 of the Framework, below** **By the end of grade 5.** Over time, people's needs and wants change, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), to decrease known risks (e.g., seatbelts in cars), and to meet societal demands (e.g., cell phones). When new technologies become available, they can bring about changes in the way people live and interact with one another.	**Macmillan/McGraw-Hill** **Discovery Education** **Britannica** Science Launch Pack: STEM	**Crosscutting Concept:** **Pattern** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **SCIENCE AND ENGINEERING PRINCIPLE:** **Engaging in argument from evidence** Students make and support claims about a proposed device or solution.

industry.			

Fourth Nine Weeks Resources	
Vocabulary: motion, speed, distance, force, gravity	
Inquiry Skills: record data, observe, infer, draw conclusions	
Plans	Design and create structures that will withstand simulated forces of strong wind or earthquakes.
Background for Teachers	Lego blocks, popsicle sticks, spaghetti, and the like are good inexpensive items to create and design structures for this activity.
Other Student Activities	Write and evaluate the expressions related to speed of tsunami, jet stream, tornado, jet plane etc. Find out the cost of operating a passenger plane based on the number of passengers and the time of a flight.
Other Sites	Navy STEM Careers Virtual Field Trip **Britannica- Username:** Bartlett **Password:** gopanther1 Science Launch Packs