4th Grade Science Instructional Map

The biggest change in thinking with these new standards is that we are no longer just teaching science facts, now we are teaching students to be scientists by starting with inquiry and letting students investigate and ask questions before we give them the information. This instructional map is the culmination of all the information about the new science standards into one document. Here is a breakdown of each section and what they mean:

DCI – Disciplinary Core Idea – this is your standard what you are used to seeing in the curriculum. Some standards changed grade levels, and some remained the same.

Progression of the standards can be found here https://www.tn.gov/content/dam/tn/education/standards/sci/sci_standards_reference.pdf

Explanation – This is taken from the reference guide provided by the state. This is to be used to activate students' prior knowledge and what they are expected to learn in 4th grade.

SEP – Science and Engineering Principle – these are very similar to the eight math practices that have been used in the past years. They should be taught in conjunction with the standards to enable the students to be lifelong scientists.

- Asking Questions and defining problems
- Developing and using models
- Planning and carrying out controlled investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in arguments from evidence
- Obtaining, evaluating, and communicating information

Progression of Science and Engineering Principles can be found here:
https://www.tn.gov/content/dam/tn/education/standards/sci/sci_standards_reference.pdf

CCC – Cross cutting concepts – These are concepts that are found throughout all science and show connections among the different topics. There can be multiple CCC for each topic you teach. It depends on how you want to teach it.

- Pattern
- Cause and Effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and Matter
- Structure and function
- Stability and Change

Progression of cross cutting concepts can be found here:
https://www.tn.gov/content/dam/tn/education/standards/sci/sci_standards_reference.pdf

Three-dimensional learning performance – a combination of your SEP, DCI, and CCC. This is essentially your student outcome... The student will (insert SEP) in order to (insert DCI) highlighting (insert CCC).

The state has provided us with 8 lesson plans that include all aspects. You can find them here https://drive.google.com/drive/folders/1v0mTNaUwttvRwFUw1wLzuDBGi8dCVCMj. These lesson plans were not meant to be done all in one day. It should take 1-3 weeks to complete depending on the standard.

Resources:

https://www.brainpop.com/

http://studyjams.scholastic.com/studyjams/jams/science/index.htm

https://mysteryscience.com (Paid subscription, but they do a limited number of free memberships every year.)

https://mysterydoug.com (Free version of mystery science)

Youtube: Crash Course Kids Science – great introductory videos

https://docs.google.com/document/d/12p2wtd9jxOk7bTk6tSm4evLM4A4AERq6zwJ25tm2qGg/edit

https://drive.google.com/file/d/1FAcEfyt9_ReESlOskMhu1ROGkZ0UIyZp/view

How wolves Change Rivers

https://www.youtube.com/watch?v=ysa5OBhXz-Q

4.ETS2: Links Among Engineering, Technology, Science, and Society (These will be incorporated throughout the year.)				
DCI	**Standard and essential questions**	**Explanation and 3-D Learning Performance**	**CCCs and SEPs**	**Vocabulary and Resources**
4.ETS2.1 *ACT	Use appropriate tools and measurements to build a model. **Essential Question:** What kind of models do scientist use?	**Explanation:** Progress in science and engineering are intertwined. As scientific understanding increases, it can provide information for the development of new processes and materials that will improve technology. These improvements permit the creation of better tools for scientific investigation. Through the use of tools, students can replicate the processes of engineers in design. As tools used in manufacturing and design progress, the production and design processes become more efficient. A recent example might include the ability to create prototypes utilizing 3D printing which produces scale models with tighter tolerances than traditional hand crafted models. To appreciate these developments, students should experience simple methods of constructing models to support their science content. Examples of appropriate tools and measurements may include rulers, scissors, glass lenses or mirrors to develop a pin-hole camera, a periscope, or kaleidoscope to explain the phenomena of visible light must bounce off an object and enter the eye for an object to be seen. **Three Dimensional Learning Performance:** Students will plan and carry out controlled investigations in order to show the use of appropriate tools and measurements to build a model highlighting that s*tudents make measurements of physical properties of objects using base units.*	***Crosscutting Concept: Scale, Proportion, and Quantity*** *Students make measurements of physical properties of objects using base units.* ***SCIENCE AND ENGINEERING PRINCIPLE: Planning and carrying out controlled investigations*** *Students can make measurements for the purpose of testing and comparing competing design solutions or understanding the effects of modifications to an existing device.*	**Resources:** HMH TN Science p.45-56 Inquiry Flip Chart p.3, 6 **Vocabulary:** prototype **Writing Task:** Have students think about the work that different type of scientists do. Tell them to write a paragraph that describes the skills possessed by one kind of scientist, such as chemist, zoologist, meteorologist, astronomer, physicist, or geologist.

4.ETS2.2 *ACT	Determine the effectiveness of multiple solutions to a design problem given the criteria and the constraints. **Essential Question:** How can you design a solution to a problem?	**EXPLANATION:** While the human imagination is boundless, the success of engineering solutions is dictated by real-world constraints. In grades K-2 student involvement in designing engineering problems focused on identifying opportunities for technology and engineering to fulfill a need or desire and recognizing the importance of a full understanding of the potential problem. In 3.ETS1, students are introduced to the principle of constraints. With this standard, students are asked to evaluate the effectiveness of various solutions, placing emphasis on incorporating the constraints into the critique of solutions that meet the proposed criteria for success. Students might examine proposed design solutions meant to minimize the human impact on the land and ocean, or means of obtaining natural resources. **Three Dimensional Learning Performance:** Students will interpret simple graphs to compare a set of solutions to a problem in order to show the effectiveness of multiple solutions to a design problem given the criteria and the constraints highlighting that interactions of the components that define a larger system.	***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 can interpret simple graphs to compare a set of solutions to a problem*	**Resources:** HMH TN Science p.77-78 Inquiry Flip Chart p.9 **Vocabulary:** solution, purpose, brainstorm **Writing Task:** Imagine a problem that you have. Write about multiple solutions to your problem. What criteria and constraints might affect the design of your solution?

4.ETS2.3 *ACT	Explain how engineers have improved existing technologies to increase their benefits, to decrease known risks, and to meet societal demands. (artificial limbs, seatbelts, cell phones). Essential Question: How do we use technology?	**EXPLANATION:** Examples can extend beyond those suggested, in the standard. The rationale behind these three was to address the three facets of the standard: 1)Improvements in artificial limbs improve the benefits of an already extant technology, 2) Seatbelts decrease the risks of injuries in car accidents, and 3) Cell phones meet the societal demand for greater connectedness and convenience. As technology changes, it creates new demands from society as previously inconceivable technologies are realized. **Three Dimensional Learning Performance:** Students will 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 in order to show how engineers have improved existing technologies to increase their benefits, to decrease known risks, and to meet societal demands. (artificial limbs, seatbelts, cell phones) highlighting that students routinely search for cause and effect relationships in systems they study.	***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.*	**Resources:** HMH TN Science p.93-94 Inquiry Flip Chart p.11 **Writing Task:** Every day, pencils are dropped on the floor, causing distracting noise. Tell students that their task is to design a pencil that, when dropped, will make little or no noise. Have students consider how they would carry out all the steps of the design process in order to develop their product.
4.ETS1.1 – Engineering Design *ACT	Categorize the effectiveness of design solutions by comparing them to specified criteria for constraints **Essential Question:** How can you design a solution to a problem?	**EXPLANATION:** While the human imagination is boundless, the success of engineering solutions is dictated by real-world constraints. In grades K-2 student involvement in designing engineering problems focused on identifying opportunities for technology and engineering to fulfill a need or desire and recognizing the importance of a full understanding of the potential problem. In 3.ETS1, students were introduced to the principle of constraints. With this standard, students are asked to evaluate the effectiveness of various solutions, placing emphasis on incorporating the constraints into the critique of solutions that meet the proposed criteria for success. Students might examine proposed design solutions meant to minimize the human impact on the land and ocean, or means of obtaining natural resources. **Three Dimensional Learning Performance:** Students will interpret simple graphs to compare a set of solutions to a problem in order to show the effectiveness of design solutions by comparing them to specified criteria for constraints highlighting that 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	**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 interpret simple graphs to compare a set of solutions to a problem.*	**Resources:** HMH TN Science p.77-78 Inquiry Flip Chart p.9 **Vocabulary:** tools, technology, system, products, designed world, feedback, process, output, input **Writing Task:** Consider the solution to the Flip Chart activity on page 9. How effective was your design in protecting the egg? Would your design create a negative impact of the environment? What changes could you make to your design to better protect the egg and the environment?

First Nine Weeks – Energy and Waves				
DCI	**Standard and essential questions**	**Explanation and 3-D Learning Performance**	**CCCs and SEPs**	**Vocabulary and Resources**
4.PS3.2 - Energy	Observe and explain the relationship between potential energy and kinetic energy **Essential Question:** What is energy? What are some forms of energy?	**EXPLANATION:** The idea that humans produce energy from nothingness is a misconception that students might possess. Energy exists in various stored forms know as potential energies. This potential energy can then be converted or released. For instance, water at high at elevation contains (gravitational) potential energy that can be harnessed by hydroelectric dams to produce electricity by spinning turbines. Food is a stored energy form that is released during digestion. Examples which build on these ideas might include using a hoop spring or elastic band to propel a toy car forward (elastic potential energy). Recognizing that deforming the spring to greater amounts increases the potential energy of the spring. Additionally, students can use electric toy cars with different numbers of batteries and observe the speeds of these cars. (electric potential energy) To "remove" batteries, but allow the car to function, the ends of the batteries can first be taped over with masking tape to prevent them from releasing energy into the circuit. The battery can then be wrapped neatly in aluminum foil and inserted into the toy as normal. The foil allows electricity to flow through the circuit. **Three Dimensional Learning Performance:** Students will carry out investigations in groups, where conditions and variables are controlled, utilize appropriate instruments, and deliberately plan multiple trials in order to show relationship between potential energy and kinetic energy highlighting that students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.	**Crosscutting Concept: Energy and Matter** *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.* **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.*	**Resources:** HMH TN Science p.101-120 Inquiry Flip Chart p.12 **Vocabulary:** energy, potential energy, kinetic energy, mechanical energy **Writing Task:** Using the data collecting during the Flip Chart investigation on page 12 decide if you would prefer to drive a hybrid car. Write a paragraph explaining why or why not using data from the activity to support your answer. **Lab/Observation:** Build a catapult. Materials: popsicle sticks, rubber bands, cheap plastic spoons (flexible), cotton balls. Show students the Pumpkin Chunkin Challenge *https://www.youtube.com/watch?v=TXNgHoIBPXM* Give student groups the materials and tell them to create a catapult. Once they have created the catapults ask them what would make their cotton ball shoot farther. They should realize the farther back the can pull their spoon, the farther their cotton ball will fly. Use this to discuss that the more energy is put into an object (potential energy) the more kinetic energy it will have.

4.SP3.3 - Energy	Describe how stored energy can be converted into another form for practical use. **Essential Questions:** How does energy change forms?	**EXPLANATION:** There are various mechanisms to store or concentrate energy to be used at a later time. Plants store up the suns energy and store this energy. When the plants are consumed, the energy can be unleased. For processes such as these to work, energy must be stored so that it can be released. A dam stores water on its uphill side, plants store energy from sunlight as they produce food, and batteries store electricity. **Three Dimensional Learning Performance:** Students will create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to show students begin to recognize types of energy present in a system and the ability to transfer this energy between objects	**Crosscutting Concept: Energy and Matter** *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.* **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.*	**Resources:** HMH TN Science p.101-120 **Vocabulary:** energy, chemical energy, electrical energy, light/heat/sound energy **Writing Task:** Using data you obtained from the Flip Chart activity on page 12 write a paragraph about how you use energy and the source of that energy on a typical school day. **Lab/Observation:** Inquiry Flip Chart p.12
4.PS3.1 - Energy	Use evidence to explain the cause and effect relationship between the speed of an object and the energy of an object. **Essential Question:** How does energy affect motion? What causes an object to start/stop moving? How are energy and speed related? How can you make an object move faster?	**EXPLANATION:** The energy of a moving object is properly referred to as kinetic energy. This knowledge is imperative to teaching 4.PS3.2. As an object's speed increases, so too does its kinetic energy. To illustrate this concept, consider dropping balls of play dough from different heights. Slow motion videos can confirm the increase in speeds when dropped from varying heights. Relating back to 2.PS3.1, students can recognize that larger changes in shape are associated with greater amounts of energy. **Three Dimensional Learning Performance:** Students will create evidence-based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to show evidence to explain the cause and effect relationship between the speed of an object and the energy of an object highlighting that students routinely search for cause and effect relationships in systems they study.	**Crosscutting Concept: Cause and Effect** *Students routinely search for cause and effect relationships in systems they study.* **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.*	**Resources:** HMH TN Science p.121- 140 **Vocabulary:** energy, kinetic energy, chemical energy, mechanical energy, position/motion, speed/velocity, force, acceleration **Writing Task:** Place a strip of carpet on the floor. At one end of the carpet, prop on end of a ruler against a stack of books. Rolla marble down the slot in the ruler so that it continues across the carpet. Write a paragraph explaining the changes in motion of the marble and the forces acting on it from beginning to end. Draw a diagram to illustrate your paragraph. **Lab/Observation:** Inquiry Flip Chart p.14-15

4.PS4.1 - ***Waves and Their Applications in Technologies for Information Transfer***	Use a model of a simple wave to explain regular patterns of amplitude, wavelength, and direction. **Essential Questions:** *What is sound?* *How can sound waves be different?* *Does sound travel the same speed through solids, liquids, and gases?*	**EXPLANATION:** Student models should explore the patterns in the shapes of both longitudinal and transverse waves as well as patterns occurring when two waves interact. Students should be able to both identify amplitude within a model for a wave, as well as identify patterns for how amplitude changes when waves interact. Students should note the effects on the direction a wave travels when it intersects another wave while traveling through a medium. Waves can be observed traveling through an elongated spring that is quickly jerked sideways and returned to center on a tile floor. Floor tiles can be used as reference points where a wave might have an amplitude of one floor tile. (Students are not responsible for boundary behaviors of waves such as reflection at a fixed end.) **Three Dimensional Learning Performance:** Student models will begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events in order to show a model of a simple wave to explain regular patterns of amplitude, wavelength, and direction highlighting students will recognize, classify, and record patterns involving rates of change	**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.*	**Resources:** HMH TN Science p.149-164 **Vocabulary:** wave, pitch, frequency, volume, wavelength, amplitude **Writing Task:** Write a paragraph explaining your observation of the movement of the ruler while conducting the experiment on page 17 of the Flip Chart. **Lab/Observation:** Inquiry Flip Chart p.17

4.SP4.3 - ***Waves and Their Applications in Technologies for Information Transfer***	Investigate how lenses and digital devices like computers or cell phones use waves to enhance human senses.	**EXPLANATION:** In 4.PS4.2, students are exposed to the bending of light as it crosses over the boundary between two materials. Students could investigate or construct varying arrangements of lenses to determine how they are utilized in devices such as eyeglasses, microscopes, or telescopes. Digital devices are devices/components of devices that are either on or off. An LCD (computer/smartphone) screen is a series of tiny lightbulbs (pixels) that can be turned on or off individually to create a picture. A model of this process might be crowds at a stadium holding pieces of colored paper above their heads to create a mosaic when viewed from above. Computers store information about which pixels are turned on an off to display an image. This stored digital information can be transmitted using waves to share pictures remotely. **Three Dimensional Learning Performance:** Students will 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 in order to show how lenses and digital devices like computers or cell phones use waves to enhance human senses highlighting that students begin to attribute the shapes of sub-components to the function of the part.	**Crosscutting Concept: Structure and Function** *Students begin to attribute the shapes of sub-components to the function of the part.* **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.*	**Resources:** HMH TN Science p.165-168, 179-190, 191-194 Inquiry Flip Chart p.20-22 **Vocabulary:** concave lens, convex lens, diffraction **Writing Task:** Using that data from your observations while performing the Flip Chart activity on page 20, compare and contrast how different lenses bend light. **Lab/Observation:** Inquiry Flip Chart p.20-22

4.PS4.2 - ***Waves and Their Applications in Technologies for Information Transfer***	Describe how the colors of available light sources and the bending of light waves determine what we see. **Essential Questions:** What is light? How does light bend?	**EXPLANATION:** In first grade, students discussed the idea that objects are visible because they either reflect or emit their own light. Light was treated as a beam of light and color was not addressed in first grade. This standard provides students the opportunity to see that white light is composed of a combination of red, green, and blue light. Students can examine and record how the appearances of objects (solid-color and multi-color) change depending on the light source. Prisms can be used to bend light so that it is separated into component colors. Lenses and combinations of lenses can bend light to magnify or focus light for objects that cannot be seen with the naked eye. (Students are not responsible for explaining the properties of materials that cause them to absorb/reflect certain colors.) **Three Dimensional Learning Performance:** Students will organize experimental data to reveal patterns and utilize data using simple graph-to-form explanations in order to show how the colors of available light sources and the bending of light waves determine what we see highlighting that students routinely search for cause and effect relationships in systems they study.	**Crosscutting Concept: Cause and Effect** *Students routinely search for cause and effect relationships in systems they study.* **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.*	**Resources:** HMH TN Science p.169-178, 179-190 **Vocabulary:** light, opaque, transparent, translucent, reflection, prism, refraction **Writing Task:** In a dark environment, have students shine a flashlight upon three objects of approximately the same size-a sheet of clear plastic, a piece of sheer cloth, and a block of wood-and analyze how the light behaves with each material. Ask students to explain their findings, using details and technical language to clarify their explanation. Encourage students to make a simple three-part diagram to illustrate the degree to which the light is absorbed by the transparent, translucent, and opaque material. **Lab/Observation:** Inquiry Flip Chart p.19-20

Second Nine Weeks – Ecosystems and Biological Change				
DCI	**Standard and essential questions**	**Explanation and 3-D Learning Performance**	**CCCs and SEPs**	**Vocabulary and Resources**
4.LS2.5 - Ecosystems: Interactions, Energy, and Dynamics	Analyze and interpret data about changes (land characteristics, water distribution, temperature, food, and other organisms) in the environment and describe what mechanisms organisms can use to affect their ability to survive and reproduce. **Essential Questions:** How are living things adapted to their environment?	**EXPLANATION:** The foundation for this standard began in first grade when students first examined the reliance of organisms on their surroundings to meet needs. Before reaching this standard, students have also examined the consequences of changes in the environment on the organisms. This standard begins to unify the core ecology ideas with those of natural selection. Environmental changes can threaten some species, while proving advantageous to others. When the ecosystem changes, some organisms will survive and reproduce while others will not. Those organisms who struggle in an environment after a change has occurred will either die off or may move to a new location. Changes to the environment may also provide opportunities for new organisms to establish themselves. The organisms that are most likely to survive may have lifestyles and structures that provide them advantages. In the instruction of this standard, it is important to introduce students to a variety of changes in the environment and make connections between these changes and the ability of the ecosystems to meet the needs of organisms. Examples of specific adaptations should be secondary discussions as those discussions appear as part of standards under life sciences disciplinary core idea 4. **Three Dimensional Learning Performance:** Students will be able to organize experimental data to reveal patterns and utilize data using simple graph to form explanations in order to show changes in the environment and describe what mechanisms organisms can use to affect their ability to survive and reproduce highlighting that students routinely search for cause and effect relationships in systems they study.	**Crosscutting Concept: Cause and Effect** *Students routinely search for cause and effect relationships in systems they study.* **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.*	**Resources:** HMH TN Science p.247-262 **Vocabulary:** adaptation, environment, physical adaptation, behavior adaptation, instinct **Writing Task:** Use the data you obtained from investigations on pages 28-29 of the Flip Chart to write about how animals adapt to survive in ever changing environments. **Lab/Observation:** Inquiry Flip Chart p.28-29

4.LS2.1 - *Ecosystems: Interactions, Energy, and Dynamics*	Support an argument with evidence that plants get the materials they need for growth and reproduction chiefly through a process in which they use carbon dioxide from the air, water, and energy from the sun to produce sugars, plant materials, and waste (oxygen); and that this process is called photosynthesis. **Essential Questions:** How do plants get energy?	**EXPLANATION:** In second grade, students were introduced to the idea that organisms depend on their environment to meet general survival needs. In third grade, students were introduced to gaseous matter in their physical sciences studies. Building on that information, students are now prepared to examine the invisible needs of plants for survival. Plants fulfill the role of "producer" which implies that nearly all types of food originated as a plant. Students can examine elodea plants in water to observe their production of gas (oxygen) under varying conditions. Bromothymol blue can be used as an indicator to show the conversion of carbon dioxide (blow bubbles into water) into oxygen by the elodea. In preparation for later grades, it should be emphasized that plant matter comes from carbon dioxide, not the soil or water. In addition to forms of matter involved with photosynthesis, discussions should include the role of plants in capturing energy from the sun and bringing this energy into the biosphere. (Instruction should be limited to the requirements for photosynthesis/plant growth and not the processes.) **Three Dimensional Learning Performance:** Students will 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 in order to show the use of evidence to support an argument that plants get the materials they need for growth and reproduction from a process called photosynthesis highlighting that Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.	**Crosscutting Concept: Energy and Matter** *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects* **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.*	**Resources:** HMH TN Science p.299-301 **Vocabulary:** photosynthesis, chlorophyll **Writing Task:** Write a paragraph detailing the results of your experiment from page 32 of the Flip Chart. Use the results to support an argument that plants get the materials they need for growth and reproduction chiefly through a process called photosynthesis. **Lab/Observation:** Inquiry Flip Chart p.32

4.LS2.4 - *Ecosystems: Interactions, Energy, and Dynamics*	Develop and use models to determine the effects of introducing a species to, or removing a species from an ecosystem and how either one can damage the balance of an ecosystem. **Essential Questions:** What are the roles of organisms in the ecosystem? What happens when and organism is removed from an ecosystem.	**EXPLANATION:** It is important that discussions of this standard extend beyond simply investigating invasive species. Instruction should have an equal focus on using the number of different species present in an ecosystem as an indication of the overall health of that ecosystem. Ecosystems can be threatened by invasive species which can outcompete native species for shared energy and resources. As a result of the inability to compete, the variety of native species decreases, reducing biodiversity. The reduced biodiversity presents the opportunity for more significant consequences from external factors, which are no longer damped by the ecosystem. When an ecosystem changes, some organisms survive while others do not, with less diversity, threats to single species prove more substantial. Models such as food webs can serve predictive functions. An example of introducing a species may include the introduction of tilapia and snakehead fish to countless streams, lakes, and rivers throughout the Indonesian Islands and other locations around the world, where these predatory fish almost always eat any native fish species to extinction. An example of removing a species might include prairie dogs, which are beneficial and contribute to the existence of the ecosystem in which they live. Without their existence, their ecosystem would be dramatically different or cease to exist altogether. **Three Dimensional Learning Performance:** Students will 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 in order to show students can develop and use models to determine the effects of introducing a species to, or removing a species from an ecosystem and how either one can damage the balance of an ecosystem highlighting that students begin to describe changes in terms of time over which they occur; their rate.	**Crosscutting Concept: Stability and Change** *Students begin to describe changes in terms of time over which they occur; their rate.* **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.*	**Resources:** HMH TN Science p.299-313 Play Oh Deer **Vocabulary:** succession, conservation, habitat **Writing Task:** Using the data collected from the activity on Flip Chart page 33, write about how introducing a species to, or removing a species from an ecosystem can change the balance of an ecosystem. **Lab/Observation:** Inquiry Flip Chart p.31-32, 34

4.LS2.2 - *Ecosystems: Interactions, Energy, and Dynamics*	Develop models of terrestrial and aquatic food chains to describe the movement of energy among producers, herbivores, carnivores, omnivores, and decomposers. **Essential Questions:** How does energy move throughout a food chain?	**EXPLANATION:** In fourth grade, students should become cognizant that living systems require energy (a term in limited use in earlier grades) in addition to matter. All ecosystems require an organism that is able to convert energy from some form into chemical energy that can be passed along a food chain. For most ecosystems on Earth, the Sun's energy is captured by photosynthetic organisms (producers) creating the foundation for energy transfer up the food chain. Consumers are organisms that eat other organisms. Based on their specific diet, consumers can be classified as either herbivores, carnivores, or omnivores. Decomposers fulfill a unique role by returning certain nutrients to the soil so that they can be reincorporated into the food chain at the producer level. There are far less substantial means of energy production, such as sulfur-reducing bacteria, that allow certain producers to obtain energy from abiotic sources. Within the biosphere, organisms have certain dietary habits that allow them to organize in a manner that tracks the flow of energy in an ecosystem. (Instruction should focus on photosynthesis as the primary means of bringing energy into the biosphere.) **Three Dimensional Learning Performance:** Student models will begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events in order to show aquatic food chains to describe the movement of energy among producers, herbivores, carnivores, omnivores, and decomposers highlighting that students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.	**Crosscutting Concept: Energy and Matter** *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.* **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.*	**Resources:** HMH TN Science p.304-310, 313-315 **Vocabulary:** producer, decomposer, consumer, herbivore, omnivore, scavenger, prey, predator, food chain **Writing Task:** Using the data your collected during the investigation of the environment on page 33 of the Flip Chart. Write about the importance of having a producer, at least on first-level consumer, and at least one second-level consumer in your ecosystem. **Lab/Observation:** Inquiry Flip Chart p.33

4.LS2.3 - *Ecosystems: Interactions, Energy, and Dynamics*	Using information about the roles of organisms (producers, consumers, decomposers), evaluate how those roles in food chains are interconnected in a food web, and communicate how the organisms are continuously able to meet their needs in a stable food web **Essential Questions:** How do food chains interact in a food web? How does energy travel in a food web?	**EXPLANATION:** The focus of this standard is on the relationships in an ecosystem. Ecosystems contain organisms that act in different ways to meet their needs. Food chains and food webs create feeding relationships. Food chains effectively organize a hierarchy or relationships based on patterns in consumption for organisms. By contrast, food webs present more realistic visualizations for the transfer of energy and matter within an ecosystem. An example of how roles of organisms are interconnected in a food web might include grass (producer) in a forest clearing, which produces its own food through photosynthesis. A rabbit (consumer-herbivore) eats the grass. A fox (consumer-carnivore) eats the rabbit. When the fox dies, decomposers such as worms and mushrooms break down its body, returning the matter and energy stored in the fox to the soil where it provides nutrients for plants like grass. *(This standard does not include discussion of various forms of symbiosis.)* **Three Dimensional Learning Performance:** Student models will begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events in order to use information about the roles of organisms (producers, consumers, decomposers), evaluate how those roles in food chains are interconnected in a food web, and communicate how the organisms are continuously able to meet their needs in a stable food web highlighting that students begin to recognize that objects have smaller substructures which determine the property of a material or system.	**Crosscutting Concept: Structure and Function** *Students begin to recognize that objects have smaller substructures which determine the property of a material or system.* **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.*	**Resources:** HMH TN Science p.316-320 **Vocabulary:** food web, energy pyramid **Writing Task:** Have student pairs choose an animal that they know well. Instruct them to draw a food web that includes the animal. The web should include at least two food chains. Each chain should include at least three organisms. Students should label each living thing in the web as a producer, consumer, or decomposer. Then students should write a paragraph in their science notebooks describing what might happen to the food web if their chosen animal were removed. **Lab/Observation:** Inquiry Flip Chart p.31, 33

Third Nine Weeks – Earth's Place in the Universe and Earth's Systems				
DCI	**Standard and essential questions**	**Explanation and 3-D Learning Performance**	**CCCs and SEPs**	**Vocabulary and Resources**
4.ESS1.2 - Earth's Place in the Universe	Use a model to explain how the orbit of the Earth and sun cause observable patterns: a. day and night; b. changes in length and direction of shadows over a day. **Essential Questions:** How do the sun, earth, and moon interact? What causes day and night? How does a shadow change throughout the day? What causes a shadow to change?	**EXPLANATION:** In 5.PS2.3, students begin to explore gravity and at that point can develop an understanding of the role of gravity and inertia in maintaining Earth's orbit. This standard sets a foundation for those discussions by leading students to make connections between the shadows that they see changing over a day and the events occurring at a planetary scale underlying those changes. These changes in the length and direction of shadows become key evidence in connecting the tilt of the Earth's axis to the formation of seasons in fifth grade. Opportunities to explore this standard might include recording the length of their shadows at preset times during the day over an extended period of time, using a spotlight/floodlight/flashlight to model this process within a classroom, and/or creating a scale model using spheres and a flashlight. **Three Dimensional Learning Performance:** Students will be able to organize experimental data to reveal patterns and utilize data using simple graph-to-form explanations in order to show how the orbit of the Earth and sun cause observable patterns: a. day and night; b. changes in length and direction of shadows over a day highlighting that students become familiar with sizes immensely large or small or durations extremely short or long.	**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 be able to organize experimental data to reveal patterns and utilize data using simple graph-to-form explanations.*	**Resources:** HMH TN Science p.335-350 Inquiry Flip Chart p.36-37 **Vocabulary:** rotate, axis, orbit, revolve, gravity, hemisphere, season **Writing Task:** Using the observations you made in the Flip Chart activity on page 37 write a paragraph explaining why shadows are sometimes long and sometimes short. Does the time of day change the length of the shadow? Explain why. **Lab/Observation:** Inquiry Flip Chart p.36-37

4.ESS1.1 – Earth's Place in the Universe	Generate and support a claim with evidence that over long periods of time, erosion (weathering and transportation) and deposition have changed landscapes and created new landforms. **Essential Questions:** **How do weathering and erosion shape earth's surface?**	**EXPLANATION:** Students should separate the processes of weathering and erosion and their roles in changing the surface of Earth. Weathering processes are more explicitly addressed in 4.ESS2.1 and pertain to the breaking down of materials. Erosive processes transport these broken down materials. The focus of this standard is on the idea that these processes occur over very long periods of time. Throughout history, there have been events such as earthquakes and volcanoes that create sudden dramatic changes to the landscape. However, gradual processes occurring continuously have also played a significant role in creating Earth's current landscape. Landforms which should be explored include local, regional, and global. Students can model the effects of weathering and erosion to create small scale landforms to understand how particular structures and formations may arise from weathering and erosion processes. **Three Dimensional Learning Performance:** Student models will begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events in order to show evidence that supports a claim that over long periods of time, erosion (weathering and transportation) and deposition have changed landscapes and created new landforms highlighting students recognize that even apparently stable systems may be undergoing imperceptible changes.	**Crosscutting Concept:** **Stability and Change** *Students recognize that even apparently stable systems may be undergoing imperceptible changes.* **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.*	**Resources:** HMH TN Science p.361-380 **Vocabulary:** weathering, erosion **Writing Task:** Provide each student with a photo of a landform in your area or state, a large index card, and colored pencils. Have students draw the landform on the unlined side of the index card. Remind them to put the name of the landform under the drawing. On the other side of the card, ask students to write three of four sentences to explain how the landform formed. **Lab/Observation:** Inquiry Flip Chart p.39,41

4.ESS2.1- Earth's Systems	Collect and analyze data from observations to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering (frost wedging, abrasion, tree root wedging) and are transported by water, ice, wind, gravity, and vegetation. **Essential Questions:** How do weathering and erosion shape earth's surface?	**EXPLANATION:** This standard focuses on the actual processes and mechanisms that break down rocks to form soils and sediments and transport these sediments. Mechanical weathering includes wearing of rock by water, ice, wind, living organisms, and gravity. Once broken down, the materials can be moved by a number of different mechanisms. Students can recreate the process of frost wedging by freezing a sealed water bottle and observing the effects. Early introductions to the idea of experimental design can be achieved by freezing an empty water bottle at the same time. (4.ESS2.1 focuses on processes whereas 4.ESS1.1 focuses on the landforms affected/created by these processes.) **Three Dimensional Learning Performance:** Students will create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering and are transported by water, ice, wind, gravity, and vegetation highlighting students identify conditions required for specific cause and effect interactions to occur through investigation.	**Crosscutting Concept: Cause and Effect** *Students identify conditions required for specific cause and effect interactions to occur through investigation.* **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.*	**Resources:** HMH TN Science p.361-376 **Vocabulary:** deposition, sediment, erosion, gravity, landform, glacier **Writing Task:** Use the data from the observations you recorded while conducting the experiment on page 39 of the Flip Chart to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering. **Lab/Observation:** Inquiry Flip Chart p.39

4.ESS2.2 – Earth's Systems	Interpret maps to determine that the location of mountain ranges, deep ocean trenches, volcanoes, and earthquakes occur in patterns. **Essential Questions:** *Can maps help us see patterns?*	**EXPLANATION:** This standard focuses on the actual processes and mechanisms that break down rocks to form soils and sediments and transport these sediments. Mechanical weathering includes wearing of rock by water, ice, wind, living organisms, and gravity. Once broken down, the materials can be moved by a number of different mechanisms. Students can recreate the process of frost wedging by freezing a sealed water bottle and observing the effects. Early introductions to the idea of experimental design can be achieved by freezing an empty water bottle at the same time. (4.ESS2.1 focuses on processes whereas 4.ESS1.1 focuses on the landforms affected/created by these processes.) **Three Dimensional Learning Performance:** Students will create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to show that the location of mountain ranges, deep ocean trenches, volcanoes, and earthquakes occur in patterns highlighting that students identify conditions required for specific cause and effect interactions to occur through investigation.	**Crosscutting Concept:** **Cause and Effect** *Students identify conditions required for specific cause and effect interactions to occur through investigation.* **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.*	**Resources:** HMH TN Science p.393A-393B, 397-400 **Vocabulary:** crust, mantle, core, earthquake, plate tectonics, epicenter, fault, volcano **Writing Task:** **Lab/Observation:** Inquiry Flip Chart p.42
4.ESS2.3 – Earth's Systems	Provide examples to support the claim that organisms affect the physical characteristics of their regions. **Essential Questions:** How do humans change the characteristics of their regions? How do animals change the characteristics of their regions?	**EXPLANATION:** These effects that organisms have on their regions can include both short-and-long term effects. Living organisms depend on the Earth to meet basic needs. Long-term effects include restructuring the surface of the land to suit human needs (e.g. building of roads, dams, fuels, agriculture) or other organisms creating habitats and shelters. Much earlier in Earth's history, it was the dramatic increases of living organisms in certain areas and that created deposits of fossil fuels for the remains of these organisms. **Three Dimensional Learning Performance:** Students will 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 in order to show that organisms affect the physical characteristics of their regions highlighting students group and describe interactions of the components that define a larger system.	**Crosscutting Concept:** **Systems and System Models** *Students group and describe interactions of the components that define a larger system.* **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.*	**Vocabulary:** natural resources, renewable resources, nonrenewable resources, watershed, recycling, pollution, fossil fuels, conservation, endangered species **Lab/Observation:**

4.ESS2.4 – Earth's Systems	Analyze and interpret data on the four layers of Earth, including thickness, composition, and physical states of these layers. **Essential Questions:** *How do movements of the crust change earth?*	**EXPLANATION:** Earth's systems include the atmosphere, hydrosphere, biosphere, and geosphere. This standard elaborates on the internal structure of the geosphere to include: the crust, mantle, outer core, and inner core. Students should develop an understanding of the relative positions, thicknesses, and compositions of these layers. Knowing the characteristics of each layer prepares students to understand processes such as convection within the mantle or radioactive decay within Earth's core. **Three Dimensional Learning Performance:** Students will organize data (observations and measurements) in a manner which facilitates further analysis and comparisons in order to show the four layers of Earth, including thickness, composition, and physical states of these layers highlighting that students group and describe interactions of the components that define a larger system.	**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 organize data (observations and measurements) in a manner which facilitates further analysis and comparisons.*	**Resources:** HMH TN Science p.382-383 **Vocabulary:** crust, mantle, core, earthquake, plate tectonics, epicenter, fault, volcano **Writing Task:** Using information you obtained from constructing the model in the Flip Chart activity on page 42, write a paragraph for each layer of the Earth describing the thickness, composition, and physical states of these layers. **Lab/Observation:** Inquiry Flip Chart p.42
4.LS4.1 - *Biological Change: Unity and Diversity*	Obtain information about what a fossil is and ways a fossil can provide information about the past. **Essential Questions:** How do fossils tell us about the past?	**EXPLANATION:** In 3.LS4.1, students were introduced to the idea that variations within a species may favor the survival of some organisms over. By extension, it is likely that this discussion also included the idea that some types of organisms that were once found on Earth have become extinct Through the use of fossil timelines we can observe changes in organisms over long periods of time. For example: We see fish without jawbones 500 million years ago, yet fossils from 400 million years ago show the emergence of jawbones. The appearance of new animal types can also be observed (amphibians 350mya, reptiles 300mya, mammals 230mya, and birds 120mya). Younger rocks contain embedded fossils that are younger and look more like the animals we see today. Examples of information could include type, size, and distribution of fossil organisms. Fossils used for examination can include both visible and microscopic. **Three Dimensional Learning Performance:** Students will create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to show information about what a fossil is and ways a fossil can provide information about the past highlighting students become familiar with sizes immensely large or small or durations extremely short or long.	**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.*	**Resources:** HMH TN Science p.401-410 **Vocabulary:** continental drift, continental shelf, glacial till, Pangaea, sediment, deposition **Lab/Observation:** Inquiry Flip Chart p.44

Fourth Nine Weeks – Earth and Human Activity and Engineering Design				
DCI	**Standard and essential questions**	**Explanation and 3-D Learning Performance**	**CCCs and SEPs**	**Vocabulary and Resources**
4.ESS3.1 – Earth and Human Activity	Obtain and combine information to describe that energy and fuels are derived from natural resources and that some energy and fuel sources are renewable (sunlight, wind, water) and some are not (fossil fuels, minerals). **Essential Questions:** What are natural resources? How do people use renewable and nonrenewable resources?	**EXPLANATION:** All material resources and energy used by humans are taken from the environment. This idea is originally presented in kindergarten when students begin to consider the ways that humans utilize the land (e.g. wood can be burnt for heating). In kindergarten, the examples given did not involve processing of the materials. Discussions of 4.ESS3.1 should also include basic discussions of how the materials are extracted or obtained to support 4.ESS3.2. These discussions do not need to involve detailed descriptions of the processes, but should focus on the general consequences of obtaining the different types of energy. (e.g., fossil fuels are extracted from deposits below Earth's surface.) The extraction processes used to obtain resources from the earth have effects on the earth. Students should develop an understanding of what differentiates the listed renewable and non-renewable resources. A full discussion relating the time to renew resources to human lifetimes will occur in 6.ESS3.1. **Three Dimensional Learning Performance:** Students will *create evidence based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations in order to show* that energy and fuels are derived from natural resources and that some energy and fuel sources are renewable and some are not, highlighting that *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.*	**Crosscutting Concept: Energy and Matter** *Students begin to recognize types of energy present in a system and the ability to transfer this energy between objects.* **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.*	**Resources:** HMH TN Science p.417-432 **Vocabulary:** natural resources, renewable resources, nonrenewable resources, watershed, fossil fuels, conservation, endangered species **Lab/Observation:** Inquiry Flip Chart p.45

4.ESS3.2 - Earth and Human Activity	Create an argument, using evidence from research, that human activity (farming, mining, building) can affect the land and ocean in positive and/or negative ways. **Essential Questions: How do people impact he ecosystem?** What are the positive and negative effects of people using natural resources?	**EXPLANATION:** As addressed in 4.ESS3.2 the processes used to obtain materials from the environment have consequences. Students should examine the activities that humans undertake and their effects. Discussions can include, but are not limited to farming, mining, and building. For example, human development frequently involves paving of roads affecting runoff in areas. Development can be carried out to include measures which deliberately minimize its effects. Examples include treatment of sewage, recycling of resources, and monitoring the byproducts of agricultural activities. **Three Dimensional Learning Performance:** Students will 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 in order to show that human activity can effect the land and ocean in positive and/or negative ways highlighting that students routinely search for cause and effect relationships in systems they study.	**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.*	**Resources:** HMH TN Science p.433-446 **Vocabulary:** biodegradable, ecosystem, environment, nonnative **Writing Task:** Have student partners choose a pair of energy resources, one renewable and one nonrenewable. Instruct them to draw a graphic organizer that shows the positive and negative effects or consequences of using each one. Students should strive for at least three positive and three negative entries for each type of resource. **Lab/Observation:** Inquiry Flip Chart p.46