Diocese of Charleston Science Standards Support Guide for Grades 3-5

These guides were developed by a curriculum team made up of teachers from across the Diocese of Charleston. The Next Generation Science Standards (NGSS) have adapted to meet the needs of the schools in the Diocese of Charleston.

DCI Arrangements of the Next Generation Science Standards

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Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four disciplinary core ideas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

Third Grade

The performance expectations in third grade help students formulate answers to questions such as: "What is typical weather in different parts of the world and during different times of the year? How can the impact of weather-related hazards be reduced? How do organisms vary in their traits? How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? What happens to organisms when their environment changes? How do equal and unequal forces on an object affect the object? How can magnets be used?" Third grade performance expectations include PS2, LS1, LS2, LS3, LS4, ESS2, and ESS3 Disciplinary Core Ideas from the *NRC Framework*. Students are able to organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. Students are expected to develop an understanding of the similarities and differences of organisms' life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is acquired by students at this level. In addition, students are able to construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of their environments. Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students are able to determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. They are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

1- PS2 Motion and Stability: Forces and Interactions

3-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]

3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

3-PS2-3. **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]

3-PS2-4. **Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence
- Science findings are based on recognizing patterns. (3-PS2-2)

Scientific Investigations Use a Variety of Methods
- Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Each force acts on one particular object and has both 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.) (3-PS2-1)
- The patterns of an object's motion in various situations can be observed and measured; when that 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.) (3-PS2-2)

PS2.B: Types of Interactions
- Objects in contact exert forces on each other. (3-PS2-1)
- Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. 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. (3-PS2-3),(3-PS2-4)

Crosscutting Concepts

Patterns
- Patterns of change can be used to make predictions. (3-PS2-2)

Cause and Effect
- Cause and effect relationships are routinely identified. (3-PS2-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.A** (3-PS2-1); **K.PS2.B** (3-PS2-1); **K.PS3.C** (3-PS2-1); **K.ETS1.A** (3-PS2-4); **1.ESS1.A** (3-PS2-2); **4.PS4.A** (3-PS2-2); **4.ETS1.A** (3-PS2-4); **5.PS2.B** (3-PS2-1); **MS.PS2.A** (3-PS2-1),(3-PS2-2); **MS.PS2.B** (3-PS2-3),(3-PS2-4); **MS.ESS1.B** (3-PS2-1),(3-PS2-2); **MS.ESS2.C** (3-PS2-1)

Cross-Curricular Connections

ELA/Literacy –
Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-PS2-1),*(3-PS2-3)
the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3)

Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence).*(3-PS2-3)*
short research projects that build knowledge about a topic. (3-PS2-1),(3-PS2-2)
Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2- 1),*(3-PS2-2)*
Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3)

Mathematics –
Reason abstractly and quantitatively. *(3-PS2-1)*
Use appropriate tools strategically. *(3-PS2-1)*
Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-1)*

2- PS2 Motion and Stability: Forces and Interactions

Faith Connections
Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

3-PS2-1.
- God calls each of us to constantly move toward a life of grace.
- All creation is a system of interrelated parts.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.

3-PS2-2.
- God created a world in which predictable patterns can be observed all around us.
- We live in a world of harmony and balance.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.

3-PS2-3.
- Even when we are not in direct contact with another, our actions can still have an impact.
- All creation is interdependent.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

3-PS2-4.
- God has given us the capabilities to examine and consider problems from multiple perspectives.
- God gives us the freedom to make choices.
- Describe how science and technology should always be at the service of humanity and, ultimately, to God, in harmony with His purposes.
- Accept the premise that nature should not be manipulated simply at people's will or only viewed as a thing to be used, but that we must cooperate with God's plan for himself and for nature.
- Accept that scientific knowledge is a call to serve and not simply a means to gain power, material prosperity, or success.

Catholic/Christian Scientists

Physics
- Roger Bacon (Franciscan friar and early advocate of the scientific method)
- André-Marie Ampère (electromagnetism)
- Antoine César Becquerel (electric and luminescent phenomena)
- André-Marie Ampère (electromagnetism)

Saints
- St. Albert the Great (Albertus Magnus), patron saint of scientists

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	Students identify and describe* the phenomenon under investigation, which includes the effects of different forces on an object's motion (e.g., starting, stopping, or changing direction).
	b	Students describe* the purpose of the investigation, which includes producing data to serve as the basis for evidence for how balanced and unbalanced forces determine an object's motion.
2	Identifying the evidence to address the purpose of the investigation	
	a	Students collaboratively develop an investigation plan. In the investigation plan, students describe* the data to be collected, including:
		i. The change in motion of an object at rest after:
		1. Different strengths and directions of balanced forces (forces that sum to zero) are applied to the object.
		2. Different strengths and directions of unbalanced forces (forces that do not sum to zero) are applied to the object (e.g., strong force on the right, weak force or the left).
		ii. What causes the forces on the object.
	b	Students individually describe* how the evidence to be collected will be relevant to determining the effects of balanced and unbalanced forces on an object's motion.
3	Planning the investigation	
	a	In the collaboratively developed investigation plan, students describe* how the motion of the object will be observed and recorded, including defining the following features:
		i. The object whose motion will be investigated.

3-PS2 Motion and Stability: Forces and Interactions

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify and describe* the phenomenon under investigation, which includes observable patterns in the motion of an object.
	b	Students identify and describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon that includes the idea that patterns of motion can be used to predict future motion of an object.
2	Identifying the evidence to address the purpose of the investigation	
	a	Based on a given investigation plan, students identify and describe* the data to be collected through observations and/or measurements, including data on the motion of the object as it repeats a pattern over time (e.g., a pendulum swinging, a ball moving on a curved track, a magnet repelling another magnet).
	b	Students describe* how the data will serve as evidence of a pattern in the motion of an object and how that pattern can be used to predict future motion.
3	Planning the investigation	
	a	From the given investigation plan, students identify and describe* how the data will be collected, including how:
		i. The motion of the object will be observed and measured.
		ii. Evidence of a pattern in the motion of the object will be identified from the data on the motion of the object.
		iii. The pattern in the motion of the object can be used to predict future motion.
4	Collecting the data	
	a	Students make observations and/or measurements of the motion of the object, according to the given investigation plan, to identify a pattern that can be used to predict future motion.

3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Observable features of the student performance by the end of the grade:		
1	Addressing phenomena of the natural world	
	a	Students ask questions that arise from observations of two objects not in contact with each other interacting through electric or magnetic forces, the answers to which would clarify the cause-and-effect relationships between:
		i. The sizes of the forces on the two interacting objects due to the distance between the two objects.
		ii. The relative orientation of two magnets and whether the force between the magnets is attractive or repulsive.
		iii. The presence of a magnet and the force the magnet exerts on other objects.
		iv. Electrically charged objects and an electric force.
2	Identifying the scientific nature of the question	
	a	Students' questions can be investigated within the scope of the classroom.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students identify and describe* a simple design problem that can be solved by applying a scientific understanding of the forces between interacting magnets.
	b	Students identify and describe* the scientific ideas necessary for solving the problem, including:
		i. Force between objects do not require that those objects be in contact with each other
		ii. The size of the force depends on the properties of objects, distance between the objects, and orientation of magnetic objects relative to one another.
2	Defining the criteria and constraints	
	a	Students identify and describe* the criteria (desirable features) for a successful solution to the problem.
	b	Students identify and describe* the constraints (limits) such as:
		i. Time.
		ii. Cost.
		iii. Materials.

3- LS1 From Molecules to Organisms: Structures and Processes

3-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop models to describe phenomena. (3-LS1-1)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science findings are based on recognizing patterns. (3-LS1-1)

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms
- Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)

Crosscutting Concepts

Patterns
- Patterns of change can be used to make predictions. (3-LS1-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **MS.LS1.B** (3-LS1-1)

Cross-Curricular Connections

ELA/Literacy –

Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). *(3-LS1-1)*

Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. *(3-LS1-1)*

Mathematics –

Model with mathematics. *(3-LS1-1)*

Number and Operations in Base Ten *(3-LS1-1)*

Number and Operations—Fractions *(3-LS1-1)*

Faith Connections

Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

- Birth, growth, reproduction, and death are God's design for all living things in creation. Our spiritual lives have cycles too.
- The Church has cycles and seasons that help us to enter deeply into the life of Christ.
- Whereas the life cycles of living things here on Earth ends with death, Jesus rose from the dead, and in doing so he made it possible for us to have life after death with Him in heaven.
- Through the Eucharist, we enter into the death and resurrection of Jesus in a special way. Like Jesus, we can be blessed, broken, given and sent out into the world.
- Exhibit care and concern at all stages of life for each human person as an image and likeness of God.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Display a sense of wonder and delight about the natural universe and its beauty.

Catholic/Christian Scientists

- Bartolomeo Eustachi (human anatomy)
- Sr. Paula González (biology)
- Antoine Laurent de Jussieu (natural classification of flowering plants)
- Andreas Vesalius (modern human anatomy)
- Theodor Schwann (theory of the cellular structure of animal organisms)
- Botany
- Carl Linnaeus
- Stephan Endlicher
- James Britton
- Andrea Cesalpino
- James Britten

Saints

- St. Ambrose, patron saint of beekeepers
- St. Ansovinus, patron saint of gardeners
- St. Anthony of Padua, patron saint of harvests and lost animals
- St. Dorothy, patron saint of horticulture
- St. Gall, patron saint of birds
- St. Isadore the Farmer, patron saint of farmers
- St. Phocus, patron saint of gardeners, agricultural workers, farm workers, farmers and field hands
- St. Urban, patron saint of grape growers
- St. Alexandra, patron saint of humanity

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop models (e.g., conceptual, physical, drawing) to describe* the phenomenon. In their models, students identify the relevant components of their models including:	
		i.	Organisms (both plant and animal).
		ii.	Birth.
		iii.	Growth.
		iv.	Reproduction.
		v.	Death.
2	Relationships		
	a	In the models, students describe* relationships between components, including:	
		i.	Organisms are born, grow, and die in a pattern known as a life cycle.
		ii.	Different organisms' life cycles can look very different.
		iii.	A causal direction of the cycle (e.g., without birth, there is no growth; without reproduction, there are no births).
3	Connections		
	a	Students use the models to describe* that although organisms can display life cycles that look different, they all follow the same pattern.	
	b	Students use the models to make predictions related to the phenomenon, based on patterns identified among life cycles (e.g., prediction could include that if there are no births, deaths will continue and eventually there will be no more of that type of organism).	

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

3-LS2-1. Construct an argument that some animals form groups that help members survive.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence, data, and/or a model. (3-LS2-1)

Disciplinary Core Ideas

LS2.D: Social Interactions and Group Behavior

- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size *(Note: Moved from K–2)*. (3-LS2-1)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS2- 1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **1.LS1.B** (3-LS2-1); **MS.LS2.A** (3-LS2-1)

Cross -Curricular Connections

ELA/Literacy –

Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS2-1)*

Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS2-1)*

Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS2-1)

Mathematics –

Model with mathematics. (3-LS2-1)

Number and Operations in Base Ten (3-LS2-1)

Faith Connections

Credited to Diocese of Owensboro Science Standards

- Animals, including humans, can experience positive results when they live in groups and work for the good of each other.
- All creation is mutually dependent for survival.
- We support one another spiritually through the church.
- Catholics believe in the communion of saints, which means that we are also supported by those who have already gone to God in heaven.
- Exhibit care and concern at all stages of life for each human person as an image and likeness of God.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Display a sense of wonder and delight about the natural universe and its beauty.

Scripture

- After the flood God makes a covenant with Noah, his sons, and all of creation: "God said to Noah and to his sons with him: 'See, I am now establishing my covenant with you and your descendants after you and with every living creature that was with you: the birds, the tame animals, and all the wild animals that were with you—all that came out of the ark. I will establish my covenant with you, that never again shall all creatures be destroyed by the waters of a flood; there shall not be another flood to devastate the earth.' God said: 'This is the sign of the covenant that I am making between me and you and every living creature with you for all ages to come: I set my bow in the clouds to serve as a sign of the covenant between me and the earth. When I bring clouds over the earth, and the bow appears in the clouds, I will remember my covenant between me and you and every living creature—every mortal being—so that the waters will never again become a flood to destroy every mortal being. When the bow appears in the clouds, I will see it and remember the everlasting covenant between God and every living creature—every mortal being that is on earth.' God told Noah: 'This is the sign of the covenant I have established between me and every mortal being that is on earth.'" (Genesis 9:8-17)

Catholic/Christian Scientists

- Rachel Carson
- Sr. Paula Gonzales

Saints

- St. Francis of Assisi, patron saint of animals and the environment
- St. Kateri Tekakwitha, patron saint of the environment and ecology

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

3-LS2-1. Construct an argument that some animals form groups that help members survive.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that some animals form groups and that being a member of that group helps each member survive.
2	Identifying scientific evidence	
	a	Students describe* the given evidence, data, and/or models necessary to support the claim, including:
		i. Identifying types of animals that form or live in groups of varying sizes.
		ii. Multiple examples of animals in groups of various sizes:
		1. Obtaining more food for each individual animal compared to the same type of animal looking for food individually.
		2. Displaying more success in defending themselves than those same animals acting alone.
		3. Making faster or better adjustments to harmful changes in their ecosystem than would those same animals acting alone.
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine its relevance, and whether it supports the claim that being a member of a group has a survival advantage.
	b	Students describe* whether the given evidence is sufficient to support the claim and whether additional evidence is needed.
4	Reasoning and synthesis	
	a	Students use reasoning to construct an argument connecting the evidence, data and/or models to the claim. Students describe* the following reasoning in their argument:
		i. The causal evidence that being part of a group can have the effect of animals being more successful in obtaining food, defending themselves, and coping with change supports the claim that being a member of a group helps animals survive.
		ii. The causal evidence that an animal losing its group status can have the effect of the animal obtaining less food, not being able to defend itself, and not being able to cope with change supports the claim that being a member of a group helps animals survive.

3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., observations, patterns) to support an explanation. (3-LS3-2)

Disciplinary Core Ideas

LS3.A: Inheritance of Traits

- Many characteristics of organisms are inherited from their parents. (3-LS3-1)
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)

LS3.B: Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)
- The environment also affects the traits that an organism develops. (3-LS3-2)

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3-1)

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS3-2)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **1.LS3.A** (3-LS3-1); **1.LS3.B** (3-LS3-1); **MS.LS1.B** (3-LS3-2); **MS.LS3.A** (3-LS3-1); **MS.LS3.B** (3-LS3-1)

Cross -Curricular Connections

ELA/Literacy –

Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2)

Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS3-1),(3-LS3-2)*

Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),*(3-LS3-2)*

Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS3-1),*(3-LS3-2)

Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS3-1),(3-LS3-2)*

Mathematics –

Reason abstractly and quantitatively. *(3-LS3-1),(3-LS3-2)*

Model with mathematics. *(3-LS3-1),(3-LS3-2)*

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS3-1),(3-LS3-2)*

Faith Connections

Credited to Diocese of Owensboro Science Standards

- God's plan for creation is relationships. Everything is interdependent.

Catholic/Christian Scientists

- Gregor Mendel (genetics through plant research)
- Jérôme Lejeune (the link of diseases to chromosome abnormalities)

Saints

- The Virgin Mary, said "yes" to Life
- St. Margaret of Castello, patron saint of pro-life groups
- St. Maximilian Kolbe, patron saint of the pro-life movement

3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students organize the data (e.g., from students' previous work, grade-appropriate existing datasets) using graphical displays (e.g., table, chart, graph). The organized data include:
		i. Traits of plant and animal parents.
		ii. Traits of plant and animal offspring.
		iii. Variations in similar traits in a grouping of similar organisms.
2	Identifying relationships	
	a	Students identify and describe* patterns in the data, including:
		i. Similarities in the traits of a parent and the traits of an offspring (e.g., tall plants typically have tall offspring).
		ii. Similarities in traits among siblings (e.g., siblings often resemble each other).
		iii. Differences in traits in a group of similar organisms (e.g., dogs come in many shapes and sizes, a field of corn plants have plants of different heights).
		iv. Differences in traits of parents and offspring (e.g., offspring do not look exactly like their parents).
		v. Differences in traits among siblings (e.g., kittens from the same mother may not look exactly like their mother).
3	Interpreting data	
	a	Students describe* that the pattern of similarities in traits between parents and offspring, and between siblings, provides evidence that traits are inherited.
	b	Students describe* that the pattern of differences in traits between parents and offspring, and between siblings, provides evidence that inherited traits can vary.
	c	Students describe* that the variation in inherited traits results in a pattern of variation in traits in groups of organisms that are of a similar type.

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

Observable features of the student performance by the end of the grade:		
1	Articulating the explanation of phenomena	
	a	Students identify the given explanation to be supported, including a statement that relates the phenomenon to a scientific idea, including that many inherited traits can be influenced by the environment.
2	Evidence	
	a	Students describe* the given evidence that supports the explanation, including:
		i. Environmental factors that vary for organisms of the same type (e.g., amount or food, amount of water, amount of exercise an animal gets, chemicals in the water) that may influence organisms' traits.
		ii. Inherited traits that vary between organisms of the same type (e.g., height or weight of a plant or animal, color or quantity of the flowers).
		iii. Observable inherited traits of organisms in varied environmental conditions
3	Reasoning	
	a	Students use reasoning to connect the evidence and support an explanation about environmental influences on inherited traits in organisms. In their chain of reasoning, students describe* a cause-and-effect relationship between a specific causal environmental factor and its effect of a given variation in a trait (e.g., not enough water produces plants that are shorter and have fewer flowers than plants that had more water available).

3-LS4 Biological Evolution: Unity and Diversity

3-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., observations, patterns) to construct an explanation. (3-LS4-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence. (3-LS4-3)
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary to 3-LS4-4)*

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: moved from K-2)* (3-LS4-1)
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

LS4.B: Natural Selection

- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)

LS4.C: Adaptation

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

LS4.D: Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS4- 2),(3-LS4-3)

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods. (3-LS4-1)

Systems and System Models

- A system can be described in terms of its components and their interactions. (3-LS4-4)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (3-LS4-1)

Connections to other DCIs in third grade: **3.LS4.C** (3-LS4-2); **3.ESS2.D** (3-LS4-3); **3.ESS3.B** (3-LS4-4)

Articulation of DCIs across grade-levels: **K.ESS3.A** (3-LS4-3)(3-LS4-4); **K.ETS1.A** (3-LS4-4); **1.LS3.A** (3-LS4-2); **2.LS2.A** (3-LS4-3),(3-LS4-4); **2.LS4.D** (3-LS4-3),(3-LS4-4); **4.ESS1.C** (3-LS4-1); **4.ESS3.B** (3-LS4-4); **4.ETS1.A** (3-LS4-4); **MS.LS2.A** (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4); **MS.LS2.C** (3-LS4-4); **MS.LS3.B** (3-LS4-2); **MS.LS4.A** (3-LS4-1); **MS.LS4.B** (3-LS4-2),(3-LS4-3); **MS.LS4.C** (3-LS4-3),(3-LS4-4); **MS.ESS1.C** (3-LS4-1),(3-LS4-3),(3-LS4-4); **MS.ESS2.B** (3-LS4-1); **MS.ESS3.C** (3-LS4-4)

Cross -Curricular Connections

ELA/Literacy –

Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS4-1),(3-LS4-2),(3-LS4-3) (3-LS4-4)*

Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3LS4-4)*

Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*

Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-LS4-1),*(3-LS4-3),*(3-LS4-4)*

Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS4-1),*(3-LS4-2),*(3-LS4-3),(3-LS4-4)*

Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1)

Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS4- 2),(3-LS4-3),(3-LS4-4)*

Mathematics –

Reason abstractly and quantitatively. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*

Model with mathematics. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*

Use appropriate tools strategically. *(3-LS4-1)*

Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *(3-LS4-2),(3-LS4-3)*

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS4-1)*

3-LS4 Biological Evolution: Unity and Diversity

Faith Connections

Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

3-LS4-1.

- God is the creator of all things.
- Fossils provide evidence that God created a world that continues to change over time.
- Spiritually we continue to change over time as we grow closer to God.
- Explain what it means to say that God created the world and all matter out of nothing at a certain point in time; how it manifests His wisdom, glory, and purpose; and how He holds everything in existence according to His plan.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.

3-LS4-2.

- This is where religion differs from a purely scientific approach.
- Theme 1: As Catholics, we believe in the life and dignity of every person, including those who are not as physically or mentally able to survive as others.
- Theme 4: The USCCB writes: "A basic moral test is how our most vulnerable members are faring. We are thus instructed to put the needs of the poor and vulnerable first."
- Theme 6: We are all one family in solidarity with one another.
- Theme 7: We are to care for all of creation, including vulnerable ecosystems.
- The Church provides a spiritual environment in which humans can survive and thrive. Jesus instituted the sacraments to give us the grace we need.
- God knows us and our needs (Psalm 139).
- Explain what it means to say that God created the world and all matter out of nothing at a certain point in time; how it manifests His wisdom, glory, and purpose; and how He holds everything in existence according to His plan.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.
- Explain how science properly limits its focus to "how" things physically exist and is not designed to answer issues of meaning, the value of things, or the mysteries of the human person.
- Describe how the use of the scientific method to explore and understand nature differs, yet complements, the theological and philosophical questions one asks in order to understand God and His works.
- Analyze the false assumption that science can replace faith.

3-LS4-3.

- As Catholics we seek out environments that support healthy physical, emotional and spiritual growth.
- The Church and the sacraments are good soil in which we can grow closer to God and one another.
- The parable of the sower and the seed (Matthew 13: 1-29; 36-43).
- Exhibit care and concern at all stages of life for each human person as an image and likeness of God.

3-LS4-4.

- God calls each of us to consider the well-being of other people, as well as plants, animals, and the environment when making choices.
- We are called to adapt and change in order to always make choices that affirm the dignity of all life.
- Choices must be made for the good of God's creation.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us.
- Describe how science and technology should always be at the service of humanity and, ultimately, to God, in harmony with His purposes.
- Share concern and care for the environment as a part of God's creation.
- Accept the premise that nature should not be manipulated simply at people's will or only viewed as a thing to be used, but that we must cooperate with God's plan for us and for nature.
- Accept that scientific knowledge is a call to serve and not simply a means to gain power, material prosperity, or success.

Scripture

- Plants in the Bible: •
  - http://ww2.odu.edu/~lmusselm/plant/bible/allbibleplantslist.php
  - http://www.newadvent.org/cathen/12149a.htm
  - Below is a list of the flowers dedicated to the Blessed Mother. (https://www.catholicculture.org/culture/library/view.cfm?recnum=5855)
    - White Lily "Annunciation Lily", symbol of Mary's Immaculate Purity.
    - Impatiens "Our Lady's Earrings", symbolical pure adornments of the ears of Mary who heard the word of God and kept it.
    - Violet symbol of Mary's humility "regarded by the Lord".
    - Lady-Slipper "Our Lady's Slipper", symbol of Mary's graceful Visitation trip to visit Elizabeth in the hill country: "All her steps were most beauteous."
    - Thistle-Down another Visitation symbol, from its graceful movement in air currents.
    - Rose symbol of the Blessed Virgin of prophecy, the Rose plant bearing the flower, Christ.
    - Daisy "Mary's Flower of God".
    - Periwinkle "Virgin Flower", emblem of the Blessed Virgin.
    - Columbine symbol of the dove of the Holy Spirit, Mary's overshadowing, indwelling, divine Spouse.
    - Pansy "Trinity Flower", symbol of the Trinity, first revealed to Mary.
    - Strawberry "Fruitful Virgin", in flower and fruit at the same time.

- "How varied are your works, Lord! In wisdom you have made them all; the earth is full of your creatures. There is the sea, great and wide! It teems with countless beings, living things both large and small." (Psalm 104: 24-25)

3-LS4 Biological Evolution: Unity and Diversity

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data, including data about:
		i. Fossils of animals (e.g., information on type, size, type of land on which it was found).
		ii. Fossils of plants (e.g., information on type, size, type of land on which it was found).
		iii. The relative ages of fossils (e.g., from a very long time ago).
		iv. Existence of modern counterparts to the fossilized plants and animals and information on where they currently live.
2	Identifying relationships	
	a	Students identify and describe* relationships in the data, including:
		i. That fossils represent plants and animals that lived long ago.
		ii. The relationships between the fossils of organisms and the environments in which they lived (e.g., marine organisms, like fish, must have lived in water environments).
		iii. The relationships between types of fossils (e.g., those of marine animals) and the current environments where similar organisms are found.
		iv. That some fossils represent organisms that lived long ago and have no modern counterparts.
		v. The relationships between fossils of organisms that lived long ago and their modern counterparts.
		vi. The relationships between existing animals and the environments in which they currently live.
3	Interpreting data	
	a	Students describe* that:
		i. Fossils provide evidence of organisms that lived long ago but have become extinct (e.g., dinosaurs, mammoths, other organisms that have no clear modern counterpart).
		ii. Features of fossils provide evidence of organisms that lived long ago and of what types of environments those organisms must have lived in (e.g., fossilized seashells indicate shelled organisms that lived in aquatic environments).

		iii. By comparing data about where fossils are found and what those environments are like, fossilized plants and animals can be used to provide evidence that some environments look very different now than they did a long time ago (e.g., fossilized seashells found on land that is now dry suggest that the area in which those fossils were found used to be aquatic; tropical plant fossils found in Antarctica, where tropical plants cannot live today, suggests that the area used to be tropical).

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Observable features of the student performance by the end of the grade:		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
	b	Students use evidence and reasoning to construct an explanation for the phenomenon.
2	Evidence	
	a	Students describe* the given evidence necessary for the explanation, including:
		i. A given characteristic of a species (e.g., thorns on a plant, camouflage of an animal, the coloration of moths).
		ii. The patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals).
		iii. Potential benefits of a given variation of the characteristic (e.g., the light coloration of some moths makes them difficult to see on the bark of a tree).
3	Reasoning	
	a	Students use reasoning to logically connect the evidence to support the explanation for the phenomenon. Students describe* a chain of reasoning that includes:
		i. That certain variations in characteristics make it harder or easier for an animal to survive, find mates, and reproduce (e.g., longer thorns prevent predators more effectively and increase the likelihood of survival; light coloration of some moths provides camouflage in certain environments, making it more likely that they will live long enough to be able to mate and reproduce).
		ii. That the characteristics that make it easier for some organisms to survive, find mates, and reproduce give those organisms an advantage over other organisms of the same species that don't have those traits.
		iii. That there can be a cause-and-effect relationship between a specific variation in a characteristic (e.g., longer thorns, coloration of moths) and its effect on the ability of the individual organism to survive and reproduce (e.g., plants with longer thorns are less likely to be eaten, darker moths are less likely to be seen and eaten on dark trees).

3-LS4 Biological Evolution: Unity and Diversity

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that in a particular habitat, some organisms can survive well, some can survive less well, and some cannot survive at all.
2	Identifying scientific evidence	
	a	Students describe* the given evidence necessary for supporting the claim, including:
		i. Characteristics of a given particular environment (e.g., soft earth, trees and shrubs, seasonal flowering plants).
		ii. Characteristics of a particular organism (e.g., plants with long, sharp leaves; rabbit coloration).
		iii. Needs of a particular organism (e.g., shelter from predators, food, water).
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine:
		i. The characteristics of organisms that might affect survival.
		ii. The similarities and differences in needs among at least three types of organisms.
		iii. How and what features of the habitat meet the needs of each of the organisms (i.e., the degree to which a habitat meets the needs of an organism).
		iv. How and what features of the habitat do not meet the needs of each of the organisms (i.e., the degree to which a habitat does not meet the needs of an organism).
	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.
4	Reasoning and synthesis	
	a	Students use reasoning to construct an argument, connecting the relevant and appropriate evidence to the claim, including describing* that any particular environment meets different organisms' needs to different degrees due to the characteristics of that environment and the needs of the organisms. Students describe* a chain of reasoning in their argument, including the following cause-and-effect relationships:
		i. If an environment fully meets the needs of an organism, that organism can survive well within that environment.
		ii. If an environment partially meets the needs of an organism, that organism can survive less well (e.g., lower survival rate, increased sickliness, shorter lifespan) than organisms whose needs are met within that environment.
		iii. If an environment does not meet the needs of the organism, that organism cannot survive within that environment.
		iv. Together, the evidence suggests a causal relationship within the system between the characteristics of a habitat and the survival of organisms within it.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim about the merit of a given solution to a problem that is caused when the environment changes, which results in changes in the types of plants and animals that live there.
2	Identifying scientific evidence	
	a	Students describe* the given evidence about how the solution meets the given criteria and constraints. This evidence includes:
		i. A system of plants, animals, and a given environment within which they live before the given environmental change occurs.
		ii. A given change in the environment.
		iii. How the change in the given environment causes a problem for the existing plants and animals living within that area.
		iv. The effect of the solution on the plants and animals within the environment.
		v. The resulting changes to plants and animals living within that changed environment, after the solution has been implemented.
3	Evaluating and critiquing evidence	
	a	Students evaluate the solution to the problem to determine the merit of the solution. Students describe* how well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		i. How well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		1. How the solution makes changes to one part (e.g., a feature of the environment) of the system, affecting the other parts of the system (e.g., plants and animals).
		2. How the solution affects plants and animals.
	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.

3-ESS2 Earth's Systems

3-ESS2 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions. (3-ESS2-1),(3-ESS2-2)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.ESS2.D** (3-ESS2-1); **4.ESS2.A** (3-ESS2-1); **5.ESS2.A** (3-ESS2-1); **MS.ESS2.C** (3-ESS2-1),(3-ESS2-2); **MS.ESS2.D** (3-ESS2-1),(3-ESS2-2)

Cross -Curricular Connections

ELA/Literacy –

Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-ESS2-2)*

Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2)

Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2)

Mathematics –

Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2)

Model with mathematics. (3-ESS2-1),(3-ESS2-2)

Use appropriate tools strategically. *(3-ESS2-1)*

Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-ESS2-1)*

Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)

Faith Connections

Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

3-ESS2-1.

- There is order and harmony in God's creation.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

3-ESS2-2.

- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Display a sense of wonder and delight about the natural universe and its beauty.

Catholic/Christian Scientists

- Evangelista Torricelli (Inventor of the barometer)

Saints

- St. Clare of Assisi, patron saint of good weather
- St. Eurosia, patron saint against bad weather

3-ESS2 Earth's Systems

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.
2	Identifying scientific evidence	
	a	Students describe* the given evidence about the design solution, including evidence about:
		i. The given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks).
		ii. Problems caused by the weather related hazard (e.g., heavy rains cause flooding, lightning causes fires).
		iii. How the proposed solution addresses the problem (e.g., dams and levees are designed to control flooding, lightning rods reduce the chance of fires) [note: mechanisms are limited to simple observable relationships that rely on logical reasoning].
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence using given criteria and constraints to determine:
		i. How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
		ii. The merits of a given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints].
		iii. The benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

Observable features of the student performance by the end of the grade:		
1	Obtaining information	
	a	Students use books and other reliable media to gather information about:
		i. Climates in different regions of the world (e.g., equatorial, polar, coastal, mid-continental).
		ii. Variations in climates within different regions of the world (e.g., variations could include an area's average temperatures and precipitation during various months over several years or an area's average rainfall and temperatures during the rainy season over several years).
2	Evaluating information	
	a	Students combine obtained information to provide evidence about the climate pattern in a region that can be used to make predictions about typical weather conditions in that region.
3	Communicating information	
	a	Students use the information they obtained and combined to describe*:
		i. Climates in different regions of the world.
		ii. Examples of how patterns in climate could be used to predict typical weather conditions.
		iii. That climate can vary over years in different regions of the world.

3-ESS3 Earth and Human Activity

3-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*

[Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-ESS3-1)

Disciplinary Core Ideas

ESS3.B: Natural Hazards

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3-ESS3-1)

Connections to Nature of Science

Science is a Human Endeavor

- Science affects everyday life. (3-ESS3-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.ESS3.B** (3-ESS3-1); **K.ETS1.A** (3-ESS3-1); **4.ESS3.B** (3-ESS3-1); **4.ETS1.A** (3-ESS3-1); **MS.ESS3.B** (3-ESS3-1)

Cross -Curricular Connections

ELA/Literacy –

Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-ESS3-1)*

Conduct short research projects that build knowledge about a topic. *(3-ESS3-1)*

Mathematics Reason abstractly and quantitatively. *(3-ESS3-1)*

Model with mathematics. *(3-ESS3-1)*

Faith Connections

Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

- By using their God-given talents, people can design solutions that reduce the impact of weather-related hazards.
- The poor often suffer the most from weather-related hazards. Catholic Social Teaching tells us to have special consideration for the needs of the poor.
- We have a responsibility to respect all of God's creation.
- Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us.
- Describe how science and technology should always be at the service of humanity and, ultimately, to God, in harmony with His purposes.

3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence about the design solution, including evidence about:	
		i.	The given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks).
		ii.	Problems caused by the weather related hazard (e.g., heavy rains cause flooding, lightning causes fires).
		iii.	How the proposed solution addresses the problem (e.g., dams and levees are designed to control flooding, lightning rods reduce the chance of fires) [note: mechanisms are limited to simple observable relationships that rely on logical reasoning].
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence using given criteria and constraints to determine:	
		i.	How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
		ii.	The merits of a given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints].
		iii.	The benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

Fourth Grade

The performance expectations in fourth grade help students formulate answers to questions such as: "What are waves and what are some things they can do? How can water, ice, wind and vegetation change the land? What patterns of Earth's features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?" Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the *NRC Framework*. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

4th Grade Evidence Statements

Faith Connections
Fourth Grade:

Credited to Diocese of Owensboro Science Standards

By using their God-given talents, people can design solutions that reduce the impact of weather-related hazards.

The poor often suffer the most from weather-related hazards.

- Catholic Social Teaching tells us to have special consideration for the needs of the poor. [CST] We have a responsibility to respect all of God's creation.
- Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us.
- Describe how science and technology should always be at the service of humanity and, ultimately, to God, in harmony with His purposes.

4-PS3 Energy

4-PS3 Energy

Students who demonstrate understanding can:

4-PS3-1. **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

4-PS3-2. **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-4. **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
- Apply scientific ideas to solve design problems. (4- PS3-4)

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer

- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

PS3.C: Relationship Between Energy and Forces

- When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

PS3.D: Energy in Chemical Processes and Everyday Life

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

ETS1.A: Defining Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. *(secondary to 4-PS3-4)*

Crosscutting Concepts

Energy and Matter

- Energy can be transferred in various ways and between objects. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World

- Engineers improve existing technologies or develop new ones. (4-PS3-4)

Connections to Nature of Science

Science is a Human Endeavor

- Most scientists and engineers work in teams. (4-PS3-4)
- Science affects everyday life. (4-PS3-4)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.B** (4-PS3-3); **K.ETS1.A** (4-PS3-4); **2.ETS1.B** (4-PS3-4); **3.PS2.A** (4-PS3-3); **5.PS3.D** (4-PS3-4); **5.LS1.C** (4-PS3-4); **MS.PS2.A** (4-PS3-3); **MS.PS2.B** (4-PS3-2); **MS.PS3.A** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.B** (4-PS3-2),(4-PS3-3),(4-PS4-4); **MS.PS3.C** (4-PS3-3); **MS.PS4.B** (4-PS3-2); **MS.ETS1.B** (4-PS3-4); **MS.ETS1.C** (4-PS3-4)

Cross -Curricular Connections

ELA/Literacy –

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4- PS3-1)
Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. *(4-PS3-1)*
Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4)
Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)
Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

Mathematics –

Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. *(4-PS3-4)*

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that the speed of a given object is related to the energy of the object (e.g., the faster an object is moving, the more energy it possesses).	
	b	Students use the evidence and reasoning to construct an explanation for the phenomenon.	
2	Evidence		
	a	Students identify and describe* the relevant given evidence for the explanation, including:	
		i.	The relative speed of the object (e.g., faster vs. slower objects).
		ii.	Qualitative indicators of the amount of energy of the object, as determined by a transfer of energy from that object (e.g., more or less sound produced in a collision, more or less heat produced when objects rub together, relative speed of a ball that was stationary following a collision with a moving object, more or less distance a stationary object is moved).
3	Reasoning		
	a	Students use reasoning to connect the evidence to support an explanation for the phenomenon. In the explanation, students describe* a chain of reasoning that includes:	
		i.	Motion can indicate the energy of an object.
		ii.	The faster a given object is moving, the more observable impact it can have on another object (e.g., a fast-moving ball striking something (a gong, a wall) makes more noise than does the same ball moving slowly and striking the same thing).
		iii.	The observable impact of a moving object interacting with its surroundings reflects how much energy was able to be transferred between objects and therefore relates to the energy of the moving object.
		iv.	Because faster objects have a larger impact on their surroundings than objects moving more slowly, they have more energy due to motion (e.g., a fast-moving ball striking a gong makes more noise than a slow-moving ball doing the same thing because it has more energy that can be transferred to the gong, producing more sound). [Note: This refers only to relative bulk motion energy, not potential energy, to remain within the DCI.]
		v.	Therefore, the speed of an object is related to the energy of the object.

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the following ideas:	
		i.	The transfer of energy, including:
			1. Collisions between objects.
			2. Light traveling from one place to another.
			3. Electric currents producing motion, sound, heat, or light.
			4. Sound traveling from one place to another.
			5. Heat passing from one object to another.
			6. Motion, sound, heat, and light causing a different type of energy to be observed after an interaction (e.g., in a collision between two objects, one object may slow down or stop, the other object may speed up, and the objects and surrounding air may be heated; a specific sound may cause the movement of an object; the energy associated with the motion of an object, via an electrical current, may be used to turn on a light).
	b	Students describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon, including the idea that energy can be transferred from place to place by:	
		i.	Moving objects.

		ii.	Sound.
		iii.	Light.
		iv.	Heat.
		v.	Electric currents.
2	Identifying the evidence to address the purpose of the investigation		
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence, including:	
		i.	The motion and collision of objects before and after an interaction (e.g., when a given object is moving fast, it can move another object farther than when the same object is moving more slowly).
		ii.	The relative presence of sound, light, or heat (including in the surrounding air) before and after an interaction (e.g. shining a light on an object can increase the temperature of the object; a sound can move an object).
		iii.	The presence of electric currents flowing through wires causally linking one form of energy output (e.g., a moving object) to another form of energy output (e.g., another moving object; turning on a light bulb).
	b	Students describe* how their observations will address the purpose of the investigation, including how the observations will provide evidence that energy, in the form of light, sound, heat, and motion, can be transferred from place to place by sound, light, heat, or electric currents (e.g., in a system in which the motion of an object generates an observable electrical current to turn on a light, energy (from the motion of an object) must be transferred to another place (energy in the form of the light bulb) via the electrical current, because the motion doesn't cause the light bulb to light up if the wire is not completing a circuit between them; when a light is directed at an object, energy (in the form of light) must be transferred from the source of the light to its destination and can be observed in the form of heat, because if the light is blocked, the object isn't warmed.	
3	Planning the investigation		
	a	From the given investigation plan, students identify and describe* how the data will be observed and recorded, including the tools and methods for collecting data on:	
		i.	The motion and collision of objects, including any sound or heat producing the motion/collision, or produced by the motion/collision.
		ii.	The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
		iii.	The presence of electric currents in wires and the presence of energy (in the form of sound, light, heat, or motion resulting from the flow of electric currents through a device).
	b	Students describe* the number of trials, controlled variables, and experimental set up.	
4	Collecting the data		
	a	Students make and record observations according to the given investigation plan to provide evidence that:	
		i.	Energy is present whenever there are moving objects, sound, light, or heat.
		ii.	That energy has been transferred from place to place (e.g., a bulb in a circuit is not lit until a switch is closed and it lights, indicating that energy is transferred through electric current in a wire to light the bulb; a stationary ball is struck by a moving ball, causing the stationary ball to move and the moving ball to slow down, indicating that energy has been transferred from the moving ball to the stationary one).

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Observable features of the student performance by the end of the grade:		
1	Addressing phenomena of the natural world	
	a	Students ask questions about the changes in energy that occur when objects collide, the answers to which would clarify:
		i. A qualitative measure of energy (e.g., relative motion, relative speed, relative brightness) of the object before the collision.
		ii. The mechanism of energy transfer during the collision, including:
		1. The transfer of energy by contact forces between colliding objects that results in a change in the motion of the objects.
		2. The transfer of energy to the surrounding air when objects collide resulting in sound and heat.
	b	Students predict reasonable outcomes about the changes in energy that occur after objects collide, based on patterns linking object collision and energy transfer between objects and the surrounding air.
2	Identifying the scientific nature of the question	
	a	Students ask questions that can be investigated within the scope of the classroom or an outdoor environment.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Given a problem to solve, students collaboratively design a solution that converts energy from one form to another. In the design, students:
		i. Specify the initial and final forms of energy (e.g., electrical energy, motion, light).
		ii. Identify the device by which the energy will be transformed (e.g., a light bulb to convert electrical energy into light energy, a motor to convert electrical energy into energy of motion).
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria and constraints of the design, which include:
		i. Criteria:
		1. The initial and final forms of energy.
		2. Description* of how the solution functions to transfer energy from one form to another.
		ii. Constraints:
		1. The materials available for the construction of the device.
		2. Safety considerations.
3	Evaluating potential solutions	
	a	Students evaluate the proposed solution according to how well it meets the specified criteria and constraints of the problem.
4	Modifying the design solution	
	a	Students test the device and use the results of the test to address problems in the design or improve its functioning.

Faith Connections from:

Credited to Diocese of Owensboro Science Standards

4-PS3 Energy

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.
4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-PS3-4

In Jesus Christ our God becomes human, changing form, yet still maintaining divinity. God is present in three forms or persons in the Trinity.

- We can work together to solve problems in order to benefit the common good.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

- Describe how science and technology should always be at the service of humanity and, ultimately, to God, in harmony with His purposes.

4-PS4-1

Just as energy moves through a wave, the movements of the Holy Spirit move through the Church and through us. They can be set in motion through reading the scriptures, prayer, reflection, teachers and ministers of the church, Mass, the sacraments, sacramentals, and each other. • Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

Catholic/Christian Scientists

• Physics • Roger Bacon (Franciscan friar and early advocate of the scientific method) • André-Marie Ampère (electromagnetism) • Antoine César Becquerel (electric and luminescent phenomena) • Vincenzo Viviani (Viviani's theorem, Viviani's curve and his work in determining the speed of sound) • Hippolyte Fizeau (the velocity of light) • Alessandro Volta (invention of the battery) • André-Marie Ampère (electromagnetism)

Saints [SA] • St. Albert the Great (Albertus Magnus), patron saint of scientists

4-PS4 Waves and their Applications in Technologies for Information Transfer

4-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.* [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
- Develop a model to describe phenomena. (4-PS4-2)

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns. (4-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties

- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

PS4.B: Electromagnetic Radiation

- An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

PS4.C: Information Technologies and Instrumentation

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)

ETS1.C: Optimizing The Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4- PS4-3)

Cause and Effect

- Cause and effect relationships are routinely identified. (4-PS4-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Connections to other DCIs in fourth grade: **4.PS3.A** (4-PS4-1); **4.PS3.B** (4-PS4-1); **4.ETS1.A** (4-PS4-3)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-PS4-3); **1.PS4.B** (4-PS4-2); **1.PS4.C** (4-PS4-3); **2.ETS1.B** (4-PS4-3); **2.ETS1.C** (4-PS4-3); **3.PS2.A** (4-PS4-3); **MS.PS4.A** (4-PS4-1); **MS.PS4.B** (4-PS4-2); **MS.PS4.C** (4-PS4-3); **MS.LS1.D** (4-PS4-2); **MS.ETS1.B** (4-PS4-3)

Cross-Curricular Connections

ELA/Literacy –
Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. *(4-PS4-3)*
Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-PS4-1),(4-PS4-2) Mathematics –*
Model with mathematics. *(4-PS4-1),(4-PS4-2)*
Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. *(4-PS4-1),(4-PS4- 2)*

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model (e.g., diagrams, analogies, examples, abstract representations, physical models) to make sense of a phenomenon that involves wave behavior. In the model, students identify the relevant components, including:
		i. Waves.
		ii. Wave amplitude.
		iii. Wavelength.
		iv. Motion of objects.
2	Relationships	
	a	Students identify and describe* the relevant relationships between components of the model, including:
		i. Waves can be described* in terms of patterns of repeating amplitude and wavelength (e.g., in a water wave there is a repeating pattern of water being higher and then lower than the baseline level of the water).
		ii. Waves can cause an object to move.
		iii. The motion of objects varies with the amplitude and wavelength of the wave carrying it.
3	Connections	
	a	Students use the model to describe*:
		i. The patterns in the relationships between a wave passing, the net motion of the wave, and the motion of an object caused by the wave as it passes.
		ii. How waves may be initiated (e.g., by disturbing surface water or shaking a rope or spring).
		iii. The repeating pattern produced as a wave is propagated.
	b	Students use the model to describe* that waves of the same type can vary in terms of amplitude and wavelength and describe* how this might affect the motion, caused by a wave, of an object.
	c	Students identify similarities and differences in patterns underlying waves and use these patterns to describe* simple relationships involving wave amplitude, wavelength, and the motion of an object (e.g., when the amplitude increases, the object moves more).

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model to make sense of a phenomenon involving the relationship between light reflection and visibility of objects. In the model, students identify the relevant components, including:
		i. Light (including the light source).
		ii. Objects.
		iii. The path that light follows.
		iv. The eye.
2	Relationships	
	a	Students identify and describe* causal relationships between the components, including:
		i. Light enters the eye, allowing objects to be seen.
		ii. Light reflects off of objects, and then can travel and enter the eye.
		iii. Objects can be seen only if light follows a path between a light source, the object, and the eye.
3	Connections	
	a	Students use the model to describe* that in order to see objects that do not produce their own light, light must reflect off the object and into the eye.
	b	Students use the model to describe* the effects of the following on seeing an object:
		i. Removing, blocking, or changing the light source (e.g., a dimmer light).
		ii. Closing the eye.
		iii. Changing the path of the light (e.g., using mirrors to direct the path of light to allow the visualization of a previously unseen object or to change the position in which the object can be seen, using an opaque or translucent barrier between 1) the light source and the object or 2) the object and the eye to change the path light follows and the visualization of the object).

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students generate at least two design solutions, for a given problem, that use patterns to transmit a given piece of information (e.g., picture, message). Students describe* how the design solution is based on:
		i. Knowledge of digitized information transfer (e.g., information can be converted from a sound wave into a digital signal such as patterns of 1s and 0s and vice versa; visual or verbal messages can be encoded in patterns of flashes of light to be decoded by someone else across the room).
		ii. Ways that high-tech devices convert and transmit information (e.g., cell phones convert sound waves into digital signals, so they can be transmitted long distances, and then converted back into sound waves; a picture or message can be encoded using light signals to transmit the information over a long distance).
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria for the design solutions, including the accuracy of the final transmitted information and that digitized information (patterns) transfer is used.
	b	Students describe* the given constraints of the design solutions, including:
		i. The distance over which information is transmitted.
		ii. Safety considerations.
		iii. Materials available.
3	Evaluating potential solutions	
	a	Students compare the proposed solutions based on how well each meets the criteria and constraints.
	b	Students identify similarities and differences in the types of patterns used in the solutions to determine whether some ways of transmitting information are more effective than others at addressing the problem.

Faith Connections

Credited to Diocese of Owensboro Science Standards

4-LS1 From Molecules to Organisms: Structures and Processes

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-PS4-2

- God has given us the gift of sight which allows us to see objects that receive light from various sources.
- As Catholics, we may think of light both physically and spiritually, as Jesus is the Light of the world, reflecting God's love for us.
- Are we able to see the light of God's love in our lives? What things or people reflect God's love to us? What things or people keep us from reflecting God's love, as Jesus did?
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.

4-PS4-3

- We can use science and technology to build communities of love through effective communication.
- Let us be mindful of our patterns of speech and cultivate a language of love.
- We have a responsibility to communicate with others in a respectful and considerate manner, whether it be verbally, in print or digitally.
- Exhibit care and concern at all stages of life for each human person as an image and likeness of God.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- God has given us the gift of sight which allows us to see objects that receive light from various sources.
- As Catholics, we may think of light both physically and spiritually, as Jesus is the Light of the world, reflecting God's love for us.
- Are we able to see the light of God's love in our lives? What things or people reflect God's love to us? What things or people keep us from reflecting God's love, as Jesus did?
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.

Catholic/Christian Scientists

- Guglielmo Marconi (long-distance radio transmission)

Saints [SA]

- St. Isadore of Seville, patron saint of computer scientists and the Internet
- St. Lucia (or St. Lucy), patron saint of vision

4LS1 From Molecules to Organisms: Structures and Processes

4-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence, data, and/or a model. (4-LS1-1)

Disciplinary Core Ideas

LS1.A: Structure and Function

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

LS1.D: Information Processing

- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (4- LS1-1),(4-LS1-2)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **1.LS1.A** (4-LS1-1); **1.LS1.D** (4-LS1-2); **3.LS3.B** (4-LS1-1); **MS.LS1.A** (4-LS1-1),(4-LS1-2); **MS.LS1.D** (4-LS1-2)

Cross-Curricular Connections

ELA/Literacy –

Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)

Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-LS1-2)*

Mathematics –

Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. *(4-LS1-1)*

Faith Connections Credited to Diocese of Owensboro Science Standards

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-LS1

4-LS1-1

- All of God's creation is designed in such a way as to ensure the physical continuation of life. Just as plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction, we humans have internal and external structures that lead us to a sustained life in Christ.
- Our outward actions and our inner spiritual lives are to be oriented toward life in God, as we are created in the image and likeness of God.
- The church helps to nurture and sustain our inner spiritual lives through the scriptures, prayer, Mass, the sacraments, sacramental and community activities. [S] [SA]
- Our inner spiritual life is also nurtured by the beauty of creation. When we diminish the grandeur of creation, we diminish the grandeur of our souls.
- Exhibit care and concern at all stages of life for each human person as an image and likeness of God. [CS S.K6 GS1]
- Value the human body as the temple of the Holy Spirit. [CS S.K6 GS3]
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
- Share concern and care for the environment as a part of God's creation. [CS S.K6 DS2]

4-LS1-2

- In God's creation everything is in relationship with everything else through sensory perception.
- God has given animals (including humans) senses that allow them to process information and the ability to use memories to guide future actions. These God-given gifts are to be used on behalf of the common good.
- Our senses are attuned to the beauty of God's creation; we are hard-wired for God.
- Perception and memory are part of the sacred story of God's people. The story of the Exodus is the defining story of the ancient Hebrew people. The life, death and resurrection of Jesus is the defining story for Christians. These defining stories are recorded in the Bible as a history of God's love for us. [S]
- The sacraments and sacramentals engage our senses and help us to perceive God in our midst. [SA]
- Value the human body as the temple of the Holy Spirit.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.
- Describe how the use of the scientific method to explore and understand nature differs, yet complements, the theological and philosophical questions one asks in order to understand God and His works.

Catholic Identity

- Plants in the Bible: • Plants of the Bible
- Below is a list of the flowers dedicated to the Blessed Mother. Flowers dedicated to the Blessed Mother

- White Lily "Annunciation Lily", symbol of Mary's Immaculate Purity.
- Impatiens "Our Lady's Earrings", symbolic pure adornments of the ears of Mary who heard the word of God and kept it.
- Violet symbol of Mary's humility "regarded by the Lord".
- Lady-Slipper "Our Lady's Slipper", symbol of Mary's graceful Visitation trip to visit Elizabeth in the hill country: "All her steps were most beautiful."
- Thistle-Down another Visitation symbol, from its graceful movement in air currents.
- Rose symbol of the Blessed Virgin of prophecy, the Rose plant bearing the flower, Christ.
- Daisy "Mary's Flower of God".
- Periwinkle "Virgin Flower", emblem of the Blessed Virgin.
- Columbine symbol of the dove of the Holy Spirit, Mary's overshadowing, indwelling, divine Spouse.
- Pansy "Trinity Flower", symbol of the Trinity, first revealed to Mary.
- Strawberry "Fruitful Virgin", in flower and fruit at the same time. Catholic/Christian Scientists
- Louis Pasteur (bacteriology)
- Gregor Mendel (genetics through plant research)
- Bartolomeo Eustachi (one of the founders of human anatomy)
- Sr. Paula González (biology)
- Antoine Laurent de Jussieu (natural classification of flowering plants)
- Andreas Vesalius (modern human anatomy)
- Theodor Schwann (theory of the cellular structure of animal organisms)

- Botany

Carl Linnaeus • Stephan Endlicher • James Britton • Andrea Cesalpino • James Britten

- Saints [SA]

• St. Dorothy, patron saint of horticulture; • St. Isadore the Farmer, patron saint of farmers • St. Francis of Assisi, patron saint of animals and ecology • St. Gall, patron saint of birds

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In the claim, students include the idea that plants and animals have internal and external structures that function together as part of a system to support survival, growth, behavior, and reproduction.
2	Identifying scientific evidence	
	a	Students describe* the given evidence, including:
		i. The internal and external structures of selected plants and animals.
		ii. The primary functions of those structures
3	Evaluating and critiquing evidence	
	a	Students determine the strengths and weaknesses of the evidence, including whether the evidence is relevant and sufficient to support a claim about the role of internal and external structures of plants and animals in supporting survival, growth, behavior, and/or reproduction.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the relevant and appropriate evidence and construct an argument that includes the idea that plants and animals have structures that, together, support survival, growth, behavior, and/or reproduction. Students describe* a chain of reasoning that includes:
		i. Internal and external structures serve specific functions within plants and animals (e.g., the heart pumps blood to the body, thorns discourage predators).
		ii. The functions of internal and external structures can support survival, growth, behavior, and/or reproduction in plants and animals (e.g., the heart pumps blood throughout the body, which allows the entire body access to oxygen and nutrients; thorns prevent predation, which allows the plant to grow and reproduce).
		iii. Different structures work together as part of a system to support survival, growth, behavior, and/or reproduction (e.g., the heart works with the lungs to carry oxygenated blood throughout the system; thorns protect the plant, allowing reproduction via stamens and pollen to occur).

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	From a given model, students identify and describe* the relevant components for testing interactions concerning the functioning of a given natural system, including:	
		i.	Different types of information about the surroundings (e.g., sound, light, odor, temperature).
		ii.	Sense receptors able to detect different types of information from the environment.
		iii.	Brain.
		iv.	Animals' actions.
2	Relationships		
	a	Students describe* the relationships between components in the model, including:	
		i.	Different types of sense receptors detect specific types of information within the environment.
		ii.	Sense receptors send information about the surroundings to the brain.
		iii.	Information that is transmitted to the brain by sense receptors can be processed immediately as perception of the environment and/or stored as memories.
		iv.	Immediate perceptions or memories processed by the brain influence an animal's action or responses to features in the environment.
3	Connections		
	a	Students use the model to describe* that:	
		i.	Information in the environment interacts with animal behavioral output via interactions mediated by the brain.
		ii.	Different types of sensory information are relayed to the brain via different sensory receptors, allowing experiences to be perceived, stored as memories, and influence behavior (e.g., an animal sees a brown, rotten fruit and smells a bad odor — this sensory information allows the animal to use information about other fruits that appear to be rotting to make decisions about what to eat; an animal sees a red fruit and a green fruit — after eating them both, the animal learns that the red fruit is sweet and the green fruit is bitter and then uses this sensory information, perceived and stored as memories, to guide fruit selection next time).
		iii.	Sensory input, the brain, and behavioral output are all parts of a system that allow animals to engage in appropriate behaviors.
	b	Students use the model to test interactions involving sensory perception and its influence on animal behavior within a natural system, including interactions between:	
		i.	Information in the environment.
		ii.	Different types of sense receptors.
		iii.	Perception and memory of sensory information.
		iv.	Animal behavior.

4- ESS1 Earth's Place in the Universe

4-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points in an explanation. (4-ESS1-1)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- 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. (4-ESS1-1)

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS1-1)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (4-ESS1-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS1-1); **3.LS4.A** (4-ESS1-1); **MS.LS4.A** (4-ESS1-1); **MS.ESS1.C** (4-ESS1-1) **MS.ESS2.A** (4-ESS1-1); **MS.ESS2.B** (4-ESS1-1)

Cross-Curricular Connections

ELA/Literacy –

Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)

Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1)

Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS1-1)*

Mathematics –

Reason abstractly and quantitatively. *(4-ESS1-1)*

Model with mathematics. *(4-ESS1-1)*

Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS1-1)*

Faith Connections

Credited to Diocese of Owensboro Science Standards

4-ESS1 Earth's Place in the Universe

4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

4-ESS1

- God created the Earth and all its systems in different phases. Fossils in layers of rock tell the story of God's ever-changing creation.
- The transformations of creation over time can help us to think about the spiritual transformations that we experience in our lives of faith.
- We are continually transformed by God's love. If we review the layered stories of our lives, we will find the 'fossil' evidence of God's love, sometimes hidden in places we didn't expect.
- The story of salvation is a story of transformations.
- Jesus transformed death when he rose from the dead.
  Through transubstantiation the bread and wine are transformed into the body and blood of Jesus in the Eucharist.
- Explain what it means to say that God created the world and all matter out of nothing at a certain point in time; how it manifests His wisdom, glory, and purpose; and how He holds everything in existence according to His plan.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.
  Display a sense of wonder and delight about the natural universe and its beauty.

4-ESS1

Catholic/Christian Scientists

Nicolas Steno (stratigraphy) • Georgius Agricola (mineralogy) • Jean Baptiste Julien d'Omalius d'Halloy (modern geology) • René Just Haüy (crystallography) • Abraham Ortelius (created the first modern atlas and theorized on continental drift) • Wilhelm Heinrich Waagen (geologist and paleontologist) • Johann Joachim Winckelmann (scientific archaeology) • Teilhard de Chardin (paleontology)

Saints [SA]

St. Barbara, patron saint of geology

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students identify the given explanation for a phenomenon, which includes a statement about the idea that landscapes change over time.	
	b	From the given explanation, students identify the specific aspects of the explanation they are supporting with evidence.	
2	Evidence		
	a	Students identify the evidence relevant to supporting the explanation, including local and regional patterns in the following:	
		i.	Different rock layers found in an area (e.g., rock layers taken from the same location show marine fossils in some layers and land fossils in other layers).
		ii.	Ordering of rock layers (e.g., layer with marine fossils is found below layer with land fossils).
		iii.	Presence of particular fossils (e.g., shells, land plants) in specific rock layers.
		iv.	The occurrence of events (e.g., earthquakes) due to Earth forces.
3	Reasoning		
	a	Students use reasoning to connect the evidence to support particular points of the explanation, including the identification of a specific pattern of rock layers and fossils (e.g., a rock layer containing shells and fish below a rock layer containing fossils of land animals and plants is a pattern indicating that, at one point, the landscape had been covered by water and later it was dry land). Students describe* reasoning for how the evidence supports particular points of the explanation, including:	
		i.	Specific rock layers in the same location show specific fossil patterns (e.g., some lower rock layers have marine fossils, while some higher rock layers have fossils of land plants).
		ii.	Since lower layers were formed first then covered by upper layers, this pattern indicates that the landscape of the area was transformed into the landscape indicated by the upper layer (e.g., lower marine fossils indicate that, at one point, the landscape was covered by water, and upper land fossils indicate that later the landscape was dry land).
		iii.	Irregularities in the patterns of rock layers indicate disruptions due to Earth forces (e.g., a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock).

4-ESS2 Earth's Systems

4-ESS2 Earth's Systems

Students who demonstrate understanding can:

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

Analyzing and Interpreting Data

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

ESS2.E: Biogeology

- Living things affect the physical characteristics of their regions. (4-ESS2-1)

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS2-2)

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS2-1); **2.ESS2.A** (4-ESS2-1); **2.ESS2.B** (4-ESS2-2); **2.ESS2.C** (4-ESS2-2); **5.ESS2.A** (4-ESS2-1); **5.ESS2.C** (4-ESS2-2);**MS.ESS1.C** (4-ESS2-2); **MS.ESS2.A** (4-ESS2-2); **MS.ESS2.B** (4-ESS2-2)

Cross-Curricular Connections

ELA/Literacy –

Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)

Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1)

Mathematics –

Reason abstractly and quantitatively. (4-ESS2-1)

Model with mathematics. (4-ESS2-1)

Use appropriate tools strategically. (4-ESS2-1)

Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS2-1)*

Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. *(4-ESS2-1),(4-ESS2-2)*

Faith Connections *Credited to Diocese of Owensboro Science Standards*

4-ESS2 Earth's Systems

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS2-1

God's creation continues to change over time.

- How are we changed through our relationship with God? How are the rough places of resistance to God's love eroded and worn down over time?
- Isaiah 40:4 speaks of changes in landforms as a way of preparing for the coming of the Messiah. It refers to the road makers of the time creating a highway on which the Messiah would come. It also refers to the raising up of the poor and the lowering of the mighty.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. God's creation is orderly and patterned.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

ESS2-2.

God's creation is orderly and patterned.

- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation.

Catholic/Christian Scientists

• Nicolas Steno (stratigraphy)
• Georgius Agricola (mineralogy)
• Jean Baptiste Julien d'Omalius d'Halloy (modern geology)
• René Just Haüy (crystallography)
• Abraham Ortelius (created the first modern atlas and theorized on continental drift)
• Wilhelm Heinrich Waagen (geologist and paleontologist)
• Johann Joachim Winckelmann (scientific archaeology) • Teilhard de Chardin (paleontology)

Saints [SA] • St. Barbara, patron saint of geology

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the following idea: the effects of weathering or the rate of erosion of Earth's materials.
	b	From the given investigation plan, students identify the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence.
	b	From the given investigation plan, students describe* the evidence needed, based on observations and/or measurements made during the investigation, including:
		i. The change in the relative steepness of slope of the area (e.g., no slope, slight slope, steep slope).
		ii. The kind of weathering or erosion to which the Earth material is exposed.
		iii. The change in the shape of Earth materials as the result of weathering or the rate of erosion by one of the following:
		1. Motion of water.
		2. Ice (including melting and freezing processes).
		3. Wind (speed and direction).
		4. Vegetation.
	c	Students describe* how the data to be collected will serve as evidence to address the purpose of the investigation, including to help identify cause and effect relationships between weathering or erosion, and Earth materials.
3	Planning the investigation	
	a	From the given investigation plan, students describe* how the data will be collected, including:
		i. The relative speed of the flow of air or water.
		ii. The number of cycles of freezing and thawing.
		iii. The number and types of plants growing in the Earth material.
		iv. The relative amount of soil or sediment transported by erosion.
		v. The number or size of rocks transported by erosion.
		vi. The breakdown of materials by weathering (e.g., ease of breaking before or after weathering, size/number of rocks broken down).
	b	Students describe* the controlled variables, including:
		i. Those variables that affect the movement of water (e.g., flow speed, volume, slope).
		ii. Those variables that affect the movement of air.
		iii. The water temperature and forms of matter (e.g., freezing, melting, room temperature).
		iv. The presence or absence of plants growing in or on the Earth material.
4	Collecting the data	
	a	Students make and record observations according to the given investigation plan to provide evidence for the effects of weathering or the rate of erosion on Earth materials (e.g., rocks, soils, and sediment).

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students organize data using graphical displays (e.g., table, chart, graph) from maps of Earth's features (e.g., locations of mountains, continental boundaries, volcanoes, earthquakes, deep ocean trenches, ocean floor structures).
2	Identifying relationships	
	a	Students identify patterns in the location of Earth features, including the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes. These relationships include:
		i. Volcanoes and earthquakes occur in bands that are often along the boundaries between continents and oceans.
		ii. Major mountain chains form inside continents or near their edges.
3	Interpreting data	
	a	Students use logical reasoning based on the organized data to make sense of and describe* a phenomenon. In their description*, students include that Earth features occur in patterns that reflect information about how they are formed or occur (e.g., mountain ranges tend to occur on the edges of continents or inside them, the Pacific Ocean is surrounded by a ring of volcanoes, all continents are surrounded by water [assume Europe and Asia are identified as Eurasia]).

4-ESS3 Earth and Human Activity

5-

4-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Disciplinary Core Ideas

ESS3.A: Natural Resources

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

ESS3.B: Natural Hazards

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) *(Note: This Disciplinary Core Idea can also be found in 3.WC.)*

ETS1.B: Designing Solutions to Engineering Problems

- Testing a solution involves investigating how well it performs under a range of likely conditions. *(secondary to 4-ESS3-2)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Influence of Science, Engineering and Technology on Society and the Natural World

- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Connections to other DCIs in fourth grade: **4.ETS1.C** (4-ESS3-2)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-ESS3-2); **2.ETS1.B** (4-ESS3-2); **2.ETS1.C** (4-ESS3-2); **5.ESS3.C** (4-ESS3-1); **MS.PS3.D** (4-ESS3-1); **MS.ESS2.A** (4-ESS3-1),(4- ESS3-2); **MS.ESS3.A** (4-ESS3-1); **MS.ESS3.B** (4-ESS3-2); **MS.ESS3.C** (4-ESS3-1); **MS.ESS3.D** (4-ESS3-1); **MS.ETS1.B** (4-ESS3-2)

Cross-Curricular Connections

ELA/Literacy –

. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
Conduct short research projects that build knowledge through investigation of different aspects of a topic. *(4-ESS3-1)*
Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS3-1)
Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS3-1) Mathematics –*
Reason abstractly and quantitatively. *(4-ESS3-1),(4-ESS3-2)*
Model with mathematics. *(4-ESS3-1),(4-ESS3-2)*
Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1),*(4-ESS3-2)*

FAITH CONNECTIONS

- Creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature- Give examples of the beauty evident in God's creation (CS iS.K6 IS4]
- Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us. [CS S.K6 IS5]

- Display a sense of wonder and delight about the natural universe and its beauty.
- Share concern and care for the environment as a part of God's creation. [
- Accept the premise that nature should not be manipulated simply by people's will or only viewed as a thing to be used, but that we must cooperate with God's plan for us and nature. [CS S.K6 DS3]

4-ESS3-2

- Although we cannot eliminate the natural hazards, God has given humans the wisdom to determine solutions to reduce the impact.
- We are called to make choices that take the good of all creation into consideration.
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature.
- Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us. [CS S.K6 IS5]
- Share concern and care for the environment as a part of God's creation.

Scripture [S]
After the flood God makes a covenant with Noah, his sons, and all of creation: "God said to Noah and to his sons with him: 'See, I am now establishing my covenant with you and your descendants after you and with every living creature that was with you: the birds, the tame animals, and all the wild animals that were with you—all that came out of the ark. I will establish my covenant with you, that never again shall all creatures be destroyed by the waters of a flood; there shall not be another flood to devastate the earth.' God said: 'This is the sign of the covenant that I am making between me and you and every living creature with you for all ages to come: I set my bow in the clouds to serve as a sign of the covenant between me and the earth. When I bring clouds over the earth, and the bow appears in the clouds, I will remember my covenant between me and you and every living creature—every mortal being—so that the waters will never again become a flood to destroy every mortal being. When the bow appears in the clouds, I will see it and remember the everlasting covenant between God and every living creature—every mortal being that is on earth.' God told Noah: 'This is the sign of the covenant I have established between me and every mortal being that is on earth.'" (Genesis 9:8-17)

Catholic/Christian Scientists
Rachel Carson • Sr. Paula Gonzales Saints [SA] • St. Francis of Assisi, patron saint of animals and the environment • St. Kateri Tekakwitha, patron saint of the environment and ecology

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students gather information from books and other reliable media about energy resources and fossil fuels (e.g., fossil fuels, solar, wind, water, nuclear), including:	
		i.	How they are derived from natural sources (e.g., which natural resource they are derived from) [note: mechanisms should be limited to grade appropriate descriptions*, such as comparing the different ways energy resources are each derived from a natural resource).
		ii.	How they address human energy needs.
		iii.	The positive and negative environmental effects of using each energy resource.
2	Evaluating information		
	a	Students combine the obtained information to provide evidence about:	
		i.	The effects on the environment of using a given energy resource.
		ii.	Whether the energy resource is renewable.
		iii.	The role of technology, including new and improved technology, in improving or mediating the environmental effects of using a given resource.
3	Communicating information		
	a	Students use the information they obtained and combined to describe* the causal relationships between:	
		i.	Energy resources and the environmental effects of using that energy source.
		ii.	The role of technology in extracting and using an energy resource.

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Given a natural Earth process that can have a negative effect on humans (e.g., an earthquake, volcano, flood, landslide), students use scientific information about that Earth process and its effects to design at least two solutions that reduce its effect on humans.
	b	In their design solutions, students describe* and use cause and effect relationships between the Earth process and its observed effect.
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria for the design solutions, including using scientific information about the Earth process to describe* how well the design must alleviate the effect of the Earth process on humans.
	b	Students describe* the given constraints of the solution (e.g., cost, materials, time, relevant scientific information), including performance under a range of likely conditions.
3	Evaluating potential solutions	
	a	Students evaluate each design solution based on whether and how well it meets the each of the given criteria and constraints.
	b	Students compare the design solutions to each other based on how well each meets the given criteria and constraints.
	c	Students describe* the design solutions in terms of how each alters the effect of the Earth process on humans.

Fifth Grade

The performance expectations in fifth grade help students formulate answers to questions such as: "When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?" Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 Disciplinary Core Ideas from the *NRC Framework*. Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals' food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas. In the fifth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, engaging in argument from evidence, and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

5th Grade Evidence Statements

6-PS1 Matter and Its Interactions

5-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena. (5-PS1-1)

Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- 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. 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 and the effects of air on larger particles or objects. (5-PS1-1)
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- Measurements of a variety of properties can be used to identify 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.) (5-PS1-3)

PS1.B: Chemical Reactions

- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- 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.) (5-PS1-2)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)

Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large. (5-PS1-1)
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1- 2),(5-PS1-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (5-PS1-2)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **2.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3); **2.PS1.B** (5-PS1-2),(5-PS1-4); **MS.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3),(5-PS1-4); **MS.PS1.B** (5-PS1-2),(5-PS1-4)

Cross-Curricular Connections

ELA/Literacy –

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS1-1)*

Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. *(5-PS1-2),(5-PS1-3),*(5-PS1-4)

Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(5-PS1-2),(5-PS1-3),*(5-PS1-4)

Draw evidence from literary or informational texts to support analysis, reflection, and research. *(5-PS1-2),(5-PS1-3),(5-PS1-4)*

Mathematics –

Reason abstractly and quantitatively. *(5-PS1-1),*(5-PS1-2),(5-PS1-3)

Model with mathematics. *(5-PS1-1),*(5-PS1-2),(5-PS1-3)

Use appropriate tools strategically. (5-PS1-2),(5-PS1-3)

Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when the decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. *(5-PS1-1)*

Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. *(5-PS1-1)*

Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. *(5-PS1-2)*

Recognize volume as an attribute of solid figures and understand concepts of volume measurement. *(5-PS1-1)*

Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. *(5-PS1-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

- The Nicene Creed states: "We believe in one God, the Father, the Almighty, Maker of all that is, seen and unseen."

• All of God's creation is made up of particles too small to be seen. We humans share this condition with the rest of creation; everything is related in one sacred whole.
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Give examples of the beauty evident in God's creation. [CS S.K6 IS4]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
• Analogy: Although humans change and grow, at the level of the soul we have an unchanging identity.
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Individually and together, we, the Body of Christ on Earth, have observable characteristics.

Catholic/Christian Scientists
• Physics: • Blaise Pascal (mathematician, physicist, inventor)
• Chemistry: • Amedeo Avogadro • Roger Joseph Bosovich • Jean-Baptiste Dumas • Joseph Louis Gay Lussac • Antoine Lavoisier
• Physiology/Medicine: • Karl Landsteiner • Leonardo da Vinci • Lazzaro Spallanzani
• Pharmacology: • Illia Delio, O.S.F. • Roger Bacon (Franciscan friar and early advocate of the scientific method)

Saints [SA]
• St. Albert the Great (Albertus Magnus) (Catholic bishop), patron saint of scientists
• Sts. Cosmas and Damian, (pharmacists) patron saints of chemistry
• St. John Leonardi, patron saint of pharmacologists

Evidence Statement

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model to describe* a phenomenon that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including:
		i. Bulk matter (macroscopic observable matter; e.g., as sugar, air, water).
		ii. Particles of matter that are too small to be seen.
2	Relationships	
	a	In the model, students identify and describe* relevant relationships between components, including the relationships between:
		i. Bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
		ii. The behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in a solvent, effects of wind).
3	Connections	
	a	Students use the model to describe* how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

Observable features of the student performance by the end of the grade:		
1	Representation	
	a	Students measure and graph the given quantities using standard units, including:
		i. The weight of substances before they are heated, cooled, or mixed.
		ii. The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
2	Mathematical/computational analysis	
	a	Students measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.
	b	Students describe* the changes in properties they observe during and/or after heating, cooling, or mixing substances.
	c	Students use their measurements and calculations to describe* that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
	d	Students use measurements and descriptions* of weight, as well as the assumption of consistent patterns in natural systems, to describe* evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.

5-PS1-3. Make observations and measurements to identify materials based on their properties.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.
	b	Students identify the purpose of the investigation, which includes collecting data to serve as the basis for evidence for an explanation about the idea that materials can be identified based on their observable and measurable properties.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
		i. Properties of materials that can be used to identify those materials (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility).
	b	Students describe* how the observations and measurements will provide the data necessary to address the purpose of the investigation.
3	Planning the investigation	
	a	From the given plan investigation plan, students describe* how the data will be collected. Examples could include:
		i. Quantitative measures of properties, in standard units (e.g., grams, liters).
		ii. Observations of properties such as color, conductivity, and reflectivity.
		iii. Determination of conductors vs. nonconductors and magnetic vs. nonmagnetic materials.
	b	Students describe* how the observations and measurements they make will allow them to identify materials based on their properties.
4	Collecting the data	
	a	Students collect and record data, according to the given investigation plan.

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the mixing of two or more substances.
	b	Students identify the purpose of the investigation, which includes providing evidence for whether new substances are formed by mixing two or more substances, based on the properties of the resulting substance.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the evidence from data that will be collected, including:
		i. Quantitative (e.g., weight) and qualitative properties (e.g., state of matter, color, texture, odor) of the substances to be mixed.
		ii. Quantitative and qualitative properties of the resulting substances.
	b	Students describe* how the collected data can serve as evidence for whether the mixing of the two or more tested substances results in one or more new substances.
3	Planning the investigation	
	a	From the given investigation plan, students describe* how the data will be collected, including:
		i. How quantitative and qualitative properties of the two or more substances to be mixed will be determined and measured.
		ii. How quantitative and qualitative properties of the substances that resulted from the mixture of the two or more substances will be determined and measured.
		iii. Number of trials for the investigation.
		iv. How variables will be controlled to ensure a fair test (e.g., the temperature at which the substances are mixed, the number of substances mixed together in each trial).
4	Collecting the data	
	a	According to the investigation plan, students collaboratively collect and record data, including data about the substances before and after mixing.

5-PS2 Motion and Stability: Forces and Interactions

5-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-PS2-1)	**PS2.B: Types of Interactions** ▪ The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **3.PS2.A** (5-PS2-1); **3.PS2.B** (5-PS2-1); **MS.PS2.B** (5-PS2-1)**; MS.ESS1.B** (5-PS2-1); **MS.ESS2.C** (5-PS2-1)

Cross-Curricular Connections

ELA/Literacy –

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-PS2-1)*
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1)
Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1)

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• God pulls us toward Himself. God is the center of gravity of our spiritual lives. We are drawn together as we are pulled collectively toward God. The scripture, tradition, Church, and sacraments pull us toward God.
• He holds everything in existence according to His plan. [CS S.K6 IS1]
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]

Evidence Statement

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a phenomenon. The claim includes the idea that the gravitational force exerted by Earth on objects is directed down toward the center of Earth.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence, data, and/or models that support the claim, including:
		i. Multiple lines of evidence that indicate that the Earth's shape is spherical (e.g., observation of ships sailing beyond the horizon, the shape of the Earth's shadow on the moon during an eclipse, the changing height of the North Star above the horizon as people travel north and south).
		ii. That objects dropped appear to fall straight down.
		iii. That people live all around the spherical Earth, and they all observe that objects appear to fall straight down.
3	Evaluation and critique	
	a	Students evaluate the evidence to determine whether it is sufficient and relevant to supporting the claim.
	b	Students describe* whether any additional evidence is needed to support the claim.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the relevant and appropriate evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
		i. If Earth is spherical, and all observers see objects near them falling directly "down" to the Earth's surface, then all observers would agree that objects fall toward the Earth's center.
		ii. Since an object that is initially stationary when held moves downward when it is released, there must be a force (gravity) acting on the object that pulls the object toward the center of Earth.

5-PS3 Energy

5-PS3 Energy

Students who demonstrate understanding can:

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. [Clarification Statement: Examples of models could include diagrams, and flow charts.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Use models to describe phenomena. (5-PS3-1)	**PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. *(secondary to 5-PS3-1)*	**Energy and Matter** ▪ Energy can be transferred in various ways and between objects. (5-PS3-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **K.LS1.C** (5-PS3-1); **2.LS2.A** (5-PS3-1); **4.PS3.A** (5-PS3-1); **4.PS3.B** (5-PS3-1); **4.PS3.D** (5-PS3-1); **MS.PS3.D** (5-PS3-1); **MS.PS4.B** (5-PS3-1); **MS.LS1.C** (5-PS3-1); **MS.LS2.B** (5-PS3-1)

Cross-Curricular Connections

ELA/Literacy –
Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS3- 1)*
Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5- PS3-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• Just as the Sun is the source of energy and nourishment for animals and humans, God is the source of energy and nourishment for the people of God. We receive this food through the Eucharist. Just as Jesus is blessed, broken and given to us, so too are we called to be blessed, broken and given to one another in the service of Christ (Henri Nouwen, Life of the Beloved, 2002). [SA]
• His wisdom, glory, and purpose; and how He holds everything in existence according to His plan. [CS S.K6 IS1]
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2] • Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]

Plants in the Bible:
• http://ww2.odu.edu/~lmusselm/plant/bible/allbibleplantslist.php
• http://www.newadvent.org/cathen/12149a.htm
• Below is a list of the flowers dedicated to the Blessed Mother. (https://www.catholicculture.org/culture/library/view.cfm?recnum=5855)
• White Lily "Annunciation Lily", symbol of Mary's Immaculate Purity.
• Impatiens "Our Lady's Earrings", symbolic pure adornments of the ears of Mary who heard the word of God and kept it.
• Violet symbol of Mary's humility "regarded by the Lord".
• Lady-Slipper "Our Lady's Slipper", symbol of Mary's graceful Visitation trip to visit Elizabeth in the hill country: "All her steps were most beauteous."
• Thistle-Down another Visitation symbol, from its graceful movement in air currents.
• Rose symbol of the Blessed Virgin of prophecy, the Rose plant bearing the flower, Christ.
• Daisy "Mary's Flower of God".
• Periwinkle "Virgin Flower", emblem of the Blessed Virgin.
• Columbine symbol of the dove of the Holy Spirit, Mary's overshadowing, indwelling, divine Spouse.
• Pansy "Trinity Flower", symbol of the Trinity, first revealed to Mary.
• Strawberry "Fruitful Virgin", in flower and fruit at the same time.

Catholic/Christian Scientists
• Sr. Paula González (biology)
• Theodor Schwann (theory of the cellular structure of animal organisms)
• Botany • Carl Linnaeus
• Stephan Endlicher
• James Britton
• Andrea Cesalpino Saints [SA]
• St. Anthony of Padua, patron saint of harvests and lost animals
• St. Gall, patron saint of birds
• St. Isadore the Farmer, patron saint of farmers
• St. Phocus, patron saint of gardeners, agricultural workers, farm workers, farmers and field hands
• St. Francis of Assisi, patron saint of animals and ecology

Evidence Statement

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students use models to describe* a phenomenon that includes the idea that energy in animals' food was once energy from the sun. Students identify and describe* the components of the model that are relevant for describing* the phenomenon, including:
		i. Energy.
		ii. The sun.
		iii. Animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
		iv. Plants.
2	Relationships	
	a	Students identify and describe* the relevant relationships between components, including:
		i. The relationship between plants and the energy they get from sunlight to produce food.
		ii. The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
		iii. The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair.
3	Connections	
	a	Students use the models to describe* causal accounts of the relationships between energy from the sun and animals' needs for energy, including that:
		i. Since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
		ii. Energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

5-LS1 From Molecules to Organisms: Structures and Processes

5-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-LS1-1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants acquire their material for growth chiefly from air and water. (5-LS1-1)	**Energy and Matter** ▪ Matter is transported into, out of, and within systems. (5-LS1-1)

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS1-1)

Articulation of DCIs across grade-levels: **K.LS1.C** (5-LS1-1); **2.LS2.A** (5-LS1-1); **MS.LS1.C** (5-LS1-1)

Cross-Curricular Connections

ELA/Literacy –

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-LS1-1)*
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)
Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)

Mathematics –

Reason abstractly and quantitatively. *(5-LS1-1)*
Model with mathematics. *(5-LS1-1)*
Use appropriate tools strategically. *(5-LS1-1)*
Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. *(5-LS1-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

- Engaging in arguments from evidence is a skill we Catholics need not only for science, but also for apologetics and evangelization. Faith and reason are both important to Catholic education.
- Plants are able to get what they need primarily from the air and water. In turn, through photosynthesis, they make food for other creatures. All of creation is interconnected and participates in the web of life, in the unity of the Holy Spirit.
- Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
- Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
- Describe how the use of the scientific method to explore and understand nature differs, yet complements, the theological and philosophical questions one asks in order to understand God and His works. [CS S.K6 IS9]
- Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
- His wisdom, glory, and purpose; and how He holds everything in existence according to His plan. [CS S.K6 IS1]

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
2	Identifying scientific evidence	
	a	Students describe* the given evidence, data, and/or models that support the claim, including evidence of:
		i. Plant growth over time.
		ii. Changes in the weight of soil and water within a closed system with a plant, indicating:
		1. Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
		2. Plants' inability to grow without water.
		iii. Plants' inability to grow without air.
		iv. Air is matter (e.g., empty object vs. air filled object).
3	Evaluating and critiquing evidence	
	a	Students determine whether the evidence supports the claim, including:
		i. Whether a particular material (e.g., air, soil) is required for growth of plants.
		ii. Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
		i. During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
		ii. Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
		iii. Therefore, plants do not acquire most of the material for growth from soil.
		iv. A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
		v. Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth,

Scripture [S]
• "Look at the birds in the sky; they do not sow or reap, they gather nothing into barns, yet your heavenly Father feeds them. Are not you more important than they? Can any of you by worrying add a single moment to your life-span? Why are you anxious about clothes? Learn from the way the wild flowers grow. They do not work or spin. But I tell you that not even Solomon in all his splendor was clothed like one of them. If God so clothes the grass of the field, which grows today and is thrown into the oven tomorrow, will he not much more provide for you, O you of little faith? So do not worry and say, 'What are we to eat?' or 'What are we to drink?' or 'What are we to wear?' All these things the pagans seek. Your heavenly Father knows that you need them all. But seek first the kingdom [of God] and his righteousness, and all these things will be given you besides." (Mathew 6:26-33)

Plants in the Bible:
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• Columbine symbol of the dove of the Holy Spirit, Mary's overshadowing, indwelling, divine Spouse.
• Pansy "Trinity Flower", symbol of the Trinity, first revealed to Mary.
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• Andrea Cesalpino Saints [SA]
• St. Anthony of Padua, patron saint of harvests and lost animals
• St. Gall, patron saint of birds
• St. Isadore the Farmer, patron saint of farmers
• St. Phocus, patron saint of gardeners, agricultural workers, farm workers, farmers and field hands
• St. Francis of Assisi, patron saint of animals and ecology

Evidence Statement

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
2	Identifying scientific evidence	
	a	Students describe* the given evidence, data, and/or models that support the claim, including evidence of:
		i. Plant growth over time.
		ii. Changes in the weight of soil and water within a closed system with a plant, indicating:
		1. Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
		2. Plants' inability to grow without water.
		iii. Plants' inability to grow without air.
		iv. Air is matter (e.g., empty object vs. air filled object).
3	Evaluating and critiquing evidence	
	a	Students determine whether the evidence supports the claim, including:
		i. Whether a particular material (e.g., air, soil) is required for growth of plants.
		ii. Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
		i. During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
		ii. Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
		iii. Therefore, plants do not acquire most of the material for growth from soil.
		iv. A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
		v. Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth,

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena. (5-LS2-1)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gasses, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-LS2- 1)

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS2-1); **5.ESS2.A** (5-LS2-1)

Articulation of DCIs across grade-levels: **2.PS1.A** (5-LS2-1); **2.LS4.D** (5-LS2-1); **4.ESS2.E** (5-LS2-1); **MS.PS3.D** (5-LS2-1); **MS.LS1.C** (5-LS2-1); **MS.LS2.A** (5-LS2-1); **MS.LS2.B** (5-LS2-1)

Cross-Curricular Connections

ELA/Literacy –

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-LS2- 1)*

Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5- LS2-1)*

Mathematics –

Reason abstractly and quantitatively. *(5-LS2-1)*

Model with mathematics. *(5-LS2-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• This standard looks at how matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. We might use this as an opportunity to think about the Eucharist and transubstantiation in which bread and wine are transformed into the body and blood of Jesus; earthly food becomes bread from heaven. [SC]
• All of creation is interconnected and participates in the web of life, in the unity of the Holy Spirit. Theologian Rev. Thomas Berry taught that creation is a communion of subjects, not a collection of objects. We can relate this to the Body of Christ.
• Systems include organisms, ecosystems, and the Earth.
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
• Share concern and care for the environment as a part of God's creation. [CS S,K6 DS2]

Scripture [S]
• "As a body is one though it has many parts, and all the parts of the body, though many, are one body, so also Christ." (1 Corinthians 12:12)

Plants in the Bible:
• http://ww2.odu.edu/~lmusselm/plant/bible/allbibleplantslist.php
• http://www.newadvent.org/cathen/12149a.htm
• Below is a list of the flowers dedicated to the Blessed Mother. (https://www.catholicculture.org/culture/library/view.cfm?recnum=5855)
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• Periwinkle "Virgin Flower", emblem of the Blessed Virgin.
• Columbine symbol of the dove of the Holy Spirit, Mary's overshadowing, indwelling, divine Spouse.
• Pansy "Trinity Flower", symbol of the Trinity, first revealed to Mary.
• Strawberry "Fruitful Virgin", in flower and fruit at the same time.

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• Andrea Cesalpino Saints [SA]
• St. Anthony of Padua, patron saint of harvests and lost animals
• St. Gall, patron saint of birds
• St. Isadore the Farmer, patron saint of farmers
• St. Phocus, patron saint of gardeners, agricultural workers, farm workers, farmers and field hands
• St. Francis of Assisi, patron saint of animals and ecology

Evidence Statement

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model to describe* a phenomenon that includes the movement of matter within an ecosystem. In the model, students identify the relevant components, including:
		i. Matter.
		ii. Plants.
		iii. Animals.
		iv. Decomposers, such as fungi and bacteria.
		v. Environment.
2	Relationships	
	a	Students describe* the relationships among components that are relevant for describing* the phenomenon, including:
		i. The relationships in the system between organisms that consume other organisms, including:
		1. Animals that consume other animals.
		2. Animals that consume plants.
		3. Organisms that consume dead plants and animals.
		4. The movement of matter between organisms during consumption.
		ii. The relationship between organisms and the exchange of matter from and back into the environment (e.g., organisms obtain matter from their environments for life processes and release waste back into the environment, decomposers break down plant and animal remains to recycle some materials back into the soil).
3	Connections	
	a	Students use the model to describe*:
		i. The cycling of matter in the system between plants, animals, decomposers, and the environment.
		ii. How interactions in the system of plants, animals, decomposers, and the environment allow multiple species to meet their needs.
		iii. That newly introduced species can affect the balance of interactions in a system (e.g., a new animal that has no predators consumes much of another organism's food within the ecosystem).
		iv. That changing an aspect (e.g., organisms or environment) of the ecosystem will affect other aspects of the ecosystem.

5-ESS1 Earth's Place in the Universe

5-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Support an argument with evidence, data, or a model. (5-ESS1-1)

Disciplinary Core Ideas

ESS1.A: The Universe and its Stars

- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

ESS1.B: Earth and the Solar System

- 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 changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5- ESS1-2)

Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large. (5-ESS1- 1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **1.ESS1.A** (5-ESS1-2); **1.ESS1.B** (5-ESS1-2); **3.PS2.A** (5-ESS1-2); **MS.ESS1.A** (5-ESS1-1),(5-ESS1-2); **MS.ESS1.B** (5-ESS1-1),(5-ESS1-2)

Cross-Curricular Connections

ELA/Literacy –

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS1-1)*

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS1-1)*

Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). *(5-ESS1-1)*

Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1)

Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-ESS1-1)

Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS1-2)*

Mathematics –

Reason abstractly and quantitatively. *(5-ESS1-1)*,(5-ESS1-2)

Model with mathematics. *(5-ESS1-1)*,(5-ESS1-2)

Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. *(5-ESS1-1)*

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2)

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• Jesus is the Light of the World. As we draw closer to him, the light of Christ appears to grow larger and brighter. Like Jesus, we are called to be God's light in the world. May our light grow ever larger and brighter for all to see.
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Give examples of the beauty evident in God's creation. [CS S.K6 IS4]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
• Just as there are patterns in nature, there are also patterns in our spiritual lives. We might encourage our students to keep a journal so that they can discover the patterns of their spiritual lives – shadows of doubt, sadness or despair that lengthen at certain times; the days and nights of our relationship with God; our positions in relation to others in our lives. We might also reflect upon the liturgical year to find the patterns of light and dark that emerge.
• Describe God's relationship with humans and nature. [CS S.K6 IS6]

Scripture [S]
• "There is an appointed time for everything, and a time for every affair under the heavens. A time to give birth, and a time to die; a time to plant, and a time to uproot the plant. A time to kill, and a time to heal; a time to tear down, and a time to build. A time to weep, and a time to laugh; a time to mourn, and a time to dance. A time to scatter stones, and a time to gather them; a time to embrace, and a time to be far from embraces. A time to seek, and a time to lose; a time to keep, and a time to cast away. A time to rend, and a time to sew; a time to be silent, and a time to speak. A time to love, and a time to hate; a time of war, and a time of peace." (Ecclesiastes 3:1-8)

Catholic/Christian Scientists
• Nicolaus Copernicus (astronomer)
• G.G. Coriolis Galileo Galilei (astronomer)
• Giovanni Domenico Cassini (first to observe four of Saturn's moons and the co-discoverer of the Great Red Spot on Jupiter)
• Christopher Clavius (Jesuit, the Gregorian calendar)
• Nicolas Louis de Lacaille (cataloged stars, nebulous objects, and constellations)
• Pierre-Simon Laplace (the "Newton of France")

• Paolo dal Pozzo Toscanelli (astronomer and cosmographer) Diocese of Owensboro Science Standards Grade 5 179
• Eduard Heis (contributed the first true delineation of the Milky Way)
• Gaspard-Gustave Coriolis (the Corialis effect)
• Léon Foucault (the Foucault pendulum)
• Daniello Bartoli, Jean-Baptiste Biot. (There are many more Catholic astronomers to research. This is just a sampling.)

Saints [SA]
• St. Dominic, patron saint of astronomers

Biblical star and constellation names:
• Kimah, the Pleiades
• Kesil, Orion
• Ash, or Ayish, the Hyades
• Mezarim, the Bears (Great and Little)
• Mazzaroth, Venus (Lucifer and Hesperus)
• Hadre theman — "the chambers of the south" — Canopus, the Southern Cross, and a Centauri
• Nachash, Draco.

(For more on Astronomy in the Bible, see: http://www.newadvent.org/cathen/02029a.htm

Evidence Statement

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.	
2	Identifying scientific evidence		
	a	Students describe* the evidence, data, and/or models that support the claim, including:	
		i.	The sun and other stars are natural bodies in the sky that give off their own light.
		ii.	The apparent brightness of a variety of stars, including the sun.
		iii.	A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
		iv.	The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.	
	b	Students determine whether additional evidence is needed to support the claim.	
4	Reasoning and synthesis		
	a	Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe* a chain of reasoning that includes:	
		i.	Because stars are defined as natural bodies that give off their own light, the sun is a star.
		ii.	The sun is many times larger than Earth but appears small because it is very far away.
		iii.	Even though the sun is very far from Earth, it is much closer than other stars.
		iv.	Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
		v.	Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
		vi.	Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
		vii.	Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:	
		i.	The length and direction of shadows observed several times during one day.
		ii.	The duration of daylight throughout the year, as determined by sunrise and sunset times.
		iii.	Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
2	Identifying relationships		
	a	Students use the organized data to find and describe* relationships within the datasets, including:	
		i.	The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
		ii.	The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter.
		iii.	Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
	b	Students use the organized data to find and describe* relationships among the datasets, including:	
		i.	Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

5-ESS2 Earth's Systems

5-ESS2 Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

ESS2.C: The Roles of Water in Earth's Surface Processes

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

Crosscutting Concepts

Scale, Proportion, and Quantity

- Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS2-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS2.A** (5-ESS2-1); **2.ESS2.C** (5-ESS2-2); **3.ESS2.D** (5-ESS2-1); **4.ESS2.A** (5-ESS2-1); **MS.ESS2.A** (5-ESS2-1); **MS.ESS2.C** (5-ESS2-1),(5-ESS2-2); **MS.ESS2.D** (5-ESS2-1); **MS.ESS3.A** (5-ESS2-2)

Cross-Curricular Connections

ELA/Literacy –

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS2-1),(5-ESS2-2)*

Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (*5-ESS2-2)*

Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS2-1),(5-ESS2-2)*

Mathematics –

Reason abstractly and quantitatively. *(5-ESS2-1),*(5-ESS2-2)

Model with mathematics. *(5-ESS2-1),*(5-ESS2-2)

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. *(5-ESS2-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• This standard looks at how matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. We might use this as an opportunity to think about the Eucharist and transubstantiation in which bread and wine are transformed into the body and blood of Jesus; earthly food becomes bread from heaven.
• It is also an important theme of the writings of the last three Popes, most recently Pope Francis' Laudato Si'. [MA]
• The clarifying statement for this standard connects to care of God's creation. Care for God's creation is the 7th theme of Catholic Social Teaching [CST].
• All of creation is interconnected and participates in the web of life, in the unity of the Holy Spirit.
• The geosphere, biosphere, hydrosphere and atmosphere are all systems. Please revisit the introduction to Catholic Identity. See the section on systems/relational thinking.
• Describe the relationships, elements, underlying order, harmony, and meaning in God's creation. [CS S.K6 IS2]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
• Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us. (CS S.K6 IS5)
• Describe God's relationship with humans and nature. [CS S.K6 IS6] • Share concern and care for the environment as a part of God's creation. [CS S,K6 DS2]
• Accept the premise that nature should not be manipulated simply at peoples' will or only viewed as a thing to be used, but that people must cooperate with God's plan for himself and for nature. [CS S.K6 DS3]
• Accept that scientific knowledge is a call to serve and not simply a means to gain power, material prosperity, or success. [CS S.K6 DS4]

• Fresh water is a precious resource that is necessary for life. It is precious to our sacramental lives as well. We are grateful for this God given gift, especially in light of the fact that it is not readily available to all. The poor suffer the most in terms of the availability of fresh water.
• Give examples of the beauty evident in God's creation. [CS S.K6 IS4]

Scripture [S]
• "We know that all things work for good for those who love God, who are called according to his purpose." (Romans 8:28)

Catholic/Christian Scientists
• Evangelista Torricelli (Inventor of the barometer)
• Nicolas Steno (stratigraphy) • Georgius Agricola (mineralogy)
• Jean Baptiste Julien d'Omalius d'Halloy (modern geology)

- René Just Haüy (crystallography)
- Abraham Ortelius (created the first modern atlas and theorized on continental drift)
- Wilhelm Heinrich Waagen (geologist and paleontologist)
- Johann Joachim Winckelmann (scientific archaeology)
- Teilhard de Chardin (paleontology) Saints [SA]
- St. Barbara, patron saint of geology
- St. Clare of Assisi, patron saint of good weather
- St. Eurosia, patron saint against bad weather

Evidence Statement

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model, using a specific given example of a phenomenon, to describe* ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:
		i. Geosphere (i.e., solid and molten rock, soil, sediment, continents, mountains).
		ii. Hydrosphere (i.e., water and ice in the form of rivers, lakes, glaciers).
		iii. Atmosphere (i.e., wind, oxygen).
		iv. Biosphere (i.e., plants, animals [including humans]).
2	Relationships	
	a	Students identify and describe* relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).
3	Connections	
	a	Students use the model to describe* a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect the Earth's surface materials and processes in that context. Students use the model to describe* how parts of an individual Earth system:
		i. Work together to affect the functioning of that Earth system.
		ii. Contribute to the functioning of the other relevant Earth system.

5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Observable features of the student performance by the end of the grade:		
1	Representation	
	a	Students graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:
		i. Oceans.
		ii. Lakes.
		iii. Rivers.
		iv. Glaciers.
		v. Ground water.
		vi. Polar ice caps.
2	Mathematical/computational analysis	
	a	Students use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe* that:
		i. The majority of water on Earth is found in the oceans.
		ii. Most of the Earth's fresh water is stored in glaciers or underground.
		iii. A small fraction of fresh water is found in lakes, rivers, wetlands, and the atmosphere.

5-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

Disciplinary Core Ideas

ESS3.C: Human Impacts on Earth Systems

- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS3-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World.

- Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **MS.ESS3.A** (5-ESS3-1); **MS.ESS3.C** (5-ESS3-1); **MS.ESS3.D** (5-ESS3-1)

Cross-Curricular Connections

ELA/Literacy –

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS3-1)*
Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.(5-ESS3-1)
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
Draw evidence from literary or informational texts to support analysis, reflection, and research. *(5-ESS3-1)*

Mathematics –

Reason abstractly and quantitatively. *(5-ESS3-1)*
Model with mathematics. *(5-ESS3-1)*

Faith Connections: *Credited to Diocese of Owensboro Science Standards*

• Care for God's creation is the 7th theme of Catholic Social Teaching [CST]. It is also an important theme of the writings of the last three Popes, most recently Pope Francis' Laudato Si'. [MA]
• Explain how creation is an outward sign of God's love and goodness and, therefore, is "sacramental" in nature. [CS S.K6 IS3]
• Give examples of the beauty evident in God's creation. [CS S.K6 IS4]
• Display a sense of wonder and delight about the natural universe and its beauty. [CS S.K6 DS1]
• Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us. [CS S.K6 IS5]
• Describe God's relationship with humans and nature. [CS S.K6 IS6]
• Share concern and care for the environment as a part of God's creation. [CS S.K6 DS2] • Accept the premise that nature should not be manipulated simply at peoples' will or only viewed as a thing to be used, but that people must cooperate with God's plan for himself and for nature. [CS S.K6 DS3]
• Accept that scientific knowledge is a call to serve and not simply a means to gain power, material prosperity, or success. [CS S.K6 DS4]
• Care of God's creation is directly related to the life and dignity of the human person, for what we do to the web of creation, we do to ourselves. We cannot have healthy humans on an unhealthy planet. [CST]
• Exhibit care and concern at all stages of life for each human person as an image and likeness of God. [CS S.K6 GS1]
• Value the human body as the temple of the Holy Spirit. [CS S.K6 GS3] Saints [SA]
• St. Francis of Assisi, patron Saint of Ecology

Scripture [S]
• After the flood God makes a covenant with Noah, his sons, and all of creation: "God said to Noah and to his sons with him: 'See, I am now establishing my covenant with you and your descendants after you and with every living creature that was with you: the birds, the tame animals, and all the wild animals that were with you—all that came out of the ark. I will establish my covenant with you, that never again shall all creatures be destroyed by the waters of a flood; there shall not be another flood to devastate the earth.' God said: 'This is the sign of the covenant that I am making between me and you and every living creature with you for all ages to come: I set my bow in the clouds to serve as a sign of the covenant between me and the earth. When I bring clouds over the earth, and the bow appears in the clouds, I will remember my covenant between me and you and every living creature—every mortal being—so that the waters will never again become a flood to destroy every mortal being. When the bow appears in the clouds, I will see it and remember the everlasting covenant between God and every living creature—every mortal being that is on earth.' God told Noah: 'This is the sign of the covenant I have established between me and every mortal being that is on earth.'" (Genesis 9:8-17)

Catholic/Christian Scientists
• Rachel Carson
• Sr. Paula Gonzalez
• Fr. Thomas Berry (Passionist priest – religion, ecology, cultural history)

Saints [SA]
• St. Francis of Assisi, patron saint of animals and the environment
• St. Kateri Tekakwitha, patron saint of the environment and ecology

Evidence Statement

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students obtain information from books and other reliable media about:	
		i.	How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
		ii.	How a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
2	Evaluating information		
	a	Students combine information from two or more sources to provide and describe* evidence about:	
		i.	The positive and negative effects on the environment as a result of human activities.
		ii.	How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

3-5-ETS1 Engineering Design

3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- 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. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Influence of Engineering, Technology, and Science on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies. (3- 5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3-5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3)

Cross-Curricular Connections

ELA/Literacy –

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS1-2)*
Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS1-2)*
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)
Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*

Mathematics –

Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2)*

Faith Connections

Credited to Diocese of Owensboro Science Standards and The Cardinal Newman Society Catholic Curriculum Standards

3-5-ETS1-1
• Refer to Catholic Identity portion of the Grades 3-5 Engineering Design Standards below.

3-5-ETS1-2
• God has given different people different gifts and talents which allow us to design solutions to problems that exist in the world.

3-5-ETS1 Engineering Design

3-5-ETS1-3
Jesus is the prototype for humanity. Unlike all others who have come after him, he cannot be improved. • God has given different people different gifts and talents which allow us to design solutions to problems that exist in the world.

Catholic Identity

- God has given us the mental capacity to consider solutions from various angles to determine which best meets the criteria and constraints of the problem.
- Engineering may be aligned with Catholic Social Teaching, depending upon the problem being solved.
- Noah was given precise directions to build a boat to withstand the flood (Genesis 6:14-16). This story from the Bible includes valuable data – the kind that is needed for engineering.
- Building the Ark of the Covenant (Exodus 37, 38).
- Simon builds a pyramid for the remains of his brother, Jonathan (1 Maccabees 13:25–30).
- The skilled master worker lays the foundation and others build upon. Jesus is the foundation of Christian life (1 Corinthians 3:9-15). The house of God is built upon the foundation of the apostles and prophets, with Jesus as the cornerstone (Ephesians 2:19-22).

Scripture

- "Unless the Lord builds the house, those who build it labor in vain." (Psalm 127:1)
- "Everyone then who hears these words of mine and does them will be like a wise man who built his house on the rock. And the rain fell, and the floods came, and the winds blew and beat on that house, but it did not fall, because it had been founded on the rock. And everyone who hears these words of mine and does not do them will be like a foolish man who built his house on the sand. And the rain fell, and the floods came, and the winds blew and beat against that house, and it fell, and great was the fall of it." (Matthew 7:24-27)
- "Everyone who comes to me and hears my words and does them, I will show you what he is like: he is like a man building a house, who dug deep and laid the foundation on the rock. And when a flood arose, the stream broke against that house and could not shake it, because it had been well built. But the one who hears and does not do them is like a man who built a house on the ground without a foundation. When the stream broke against it, immediately it fell, and the ruin of that house was great." (Luke 6:46-49)
- "For which of you, desiring to build a tower, does not first sit down and count the cost, whether he has enough to complete it?" (Luke 14:28)
- "He is before all things, and in him all things hold together." (Colossians 1:17)
- "As you come to him, a living stone rejected by men but in the sight of God chosen and precious, you yourselves like living stones are being built up as a spiritual house, to be a holy priesthood, to offer spiritual sacrifices acceptable to God through Jesus Christ. For it stands in Scripture: 'Behold, I am laying in Zion a stone, a cornerstone chosen and precious, and whoever believes in him will not be put to shame.' So the honor is for you who believe, but for those who do not believe, 'The stone that the builders rejected has become the cornerstone,' and 'A stone of stumbling, and a rock of offense.' They stumble because they disobey the word, as they were destined to do." (1 Peter 2:4-8)

Catholic/Christian Scientists

- Johannes Gutenberg (Inventor of the printing press)

Saints

- Blessed Carlos Acutis (expected to become a Saint in 2025)
- St. Patrick, patron saint of engineers
- St. Isadore of Seville, patron saint of computer scientists and the Internet

3-5-ETS1 Engineering Design

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2	Defining the boundaries of the system	
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3	Defining the criteria and constraints	
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Observable features of the student performance by the end of the grade:		
1	Identifying the purpose of the investigation	
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
2	Identifying the evidence to be address the purpose of the investigation	
	a	Students describe* the evidence to be collected, including:
		i. How well the model/prototype performs against the given criteria and constraints.
		ii. Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii. Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.
3	Planning the investigation	
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:
		i. The specific criterion or constraint to be used.
		ii. What is to be changed in each trial (the independent variable).
		iii. The outcome (dependent variable) that will be measured to determine success.
		iv. What tools and methods are to be used for collecting data.
		v. What is to be kept the same from trial to trial to ensure a fair test.
4	Collecting the data	
	a	Students carry out the investigation, collecting and recording data according to the developed plan.

3-5-ETS1 Engineering Design

Support Materials Grades 3-5

Textbooks

Nancy Larson Grade 3
Nancy Larson Grade 4
Nancy Larson Grade 5

Science Websites

Title:	**Website:**	**Grade Level:**	**Accommodations:**
Simplify Science Subscription	Simplify Science	K- 5th NGSS Compliant	Guides Notes, Hands on Experiments, Google Compliant
IXL Subscription	IXL	K- 8th Grade and Biology South Carolina State Standards	Guides materials, Map Testing Compliance
Science Buddies	Science Buddies	Free Science and STEAM resources	Experiments
NASA STEM Activities	NASA	K-12 Science and STEM resource	Experiments, Writing Activities, and many more
STEMfinity	STEMfinity	K-12	Has free STEM resources, grants and other resources
Carly and Adam	Carly and Adam	K-8th	Free Resources Membership opportunities
Explore Learning (Gizmos)	Gizmos	3-12	Has free Gizmos which teachers have access to with their free account. Please note they change every semester.
Illinois Math and Science Academy	https://www.imsa.edu/educator-development/next-generation-science-standards/	K-5	NGSS aligned lessons
The Wonder of Science	https://thewonderofscience.com/	K-HS	Resources aligned with NGSS
Starrmatica Science Reading Book Lists	starrmatica.com	Leveled science reading books that are NGSS aligned	Website of resources. Starrmatica resources on TPT.

Books and Resources Grade 3

Title:	Author:	Unit
Mel and Mo's Marvelous Balancing Act	Nicola Winstanley	3-PS2-1 Motion and Stability

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Newton and Me	Lynne Mayer	3-PS2-1 Motion and Stability
Move It! Motion, forces, and you	Adrienne Mason	3-PS2-2 Motion and Stability
Forces Make Things Move	Kimberly Brubaker Bradley	3-PS2-2 Motion and Stability
Magnets Push, Magnets Pul	David Adler	3-PS2-3 Motion and Stability
Marsha is Magnetic	Beth Ferry	3-PS2-3 Motion and Stability
Electromagnetism for Babies	Chris Ferrie	3-PS2-4 Motion and Stability
Do Opposites Really Attract?	Tricia J. Hoover	3-PS2-4 Motion and Stability
Honeybee: The busy life of Apis Mellifera	Candace Fleming	3-LS1-1 Molecules to Organisms
The Life Cycle of an… (Oak Tree, Bean, Sunflower, Apple Tree, Carrot, Pine Tree) Series	Linda Tagliaferro	3-LS1-1 Molecules to Organisms
Packs: Strength in Numbers	Hannah Salyer	3-LS2-1 Ecosystems, Interactions, Energy and Dynamics
She Leads: The Elephant Matriarch	June Smalls	3-LS2-1 Ecosystems, Interactions, Energy and Dynamics
Thunder Birds	Jim Arnosky	3-LS2 Ecosystems: Interactions, Energy, and Dynamics
A Peek at Beaks-Tools Birds Use	Sara Levine	3-LS2 Ecosystems: Interactions, Energy, and Dynamics
Fossils Tell Stories	Yu-ri Kim	3-LS4 Biological Evolution: Unity and Diversity
Bones in the White House	Candice Ransom	3-LS4 Biological Evolution: Unity and Diversity
Hello Winter	Shelley Rotner	3-ESS2 Earth's Systems
Why do Leaves Change Colors?	Betsy Maestro	3-ESS2 Earth's Systems
The Tornado Scientist Seeing Inside Severe Storms	Mary Kay Carson	3-ESS3 Earth and Human Activity
Blizzards	John Rocco	3-ESS3 Earth and Human Activity

Books and Resources Grade 4

Title:	Author:	Unit
Energy Island	Allan Drummond	4-PS3 Energy
Roller Coaster	Marla Frazee	4-PS3 Energy
The Boy who Harnessed the Wind	Bryan Mealer	4-PS3 Energy
How High in the Sky? Flying Animals	Caroline Arnold	LS1 From Molecules to Organisms: Structures and Processes
The Greatest Dinosaur Ever	Brenda Guiberson	4-LS1 From Molecules to Organisms: Structures and Processes
The Most Amazing Creatures in the Sea	Brenda Z. Guiberson	4-LS1 From Molecules to Organisms: Structures and Processes
The Street Beneath my Feet	Charlotte Guillain and Yuval Zommer	4-ESS1 Earth's Place in the Universe
A Rock is Lively	Dianna Hutts Aston	4-ESS1 Earth's Place in the Universe
Follow the Water from Book to Ocean	Arthur Dorros	4-ESS2 Earth's Systems

3-5-ETS1 Engineering Design

The Sun, the Wind and the Rain	Lisa Westerberg Peter	4-ESS2 Earth's Systems
As the Crow Flies: A First Book of Maps	Gail Hartman	4-ESS2 Earth's Systems
Ocean Speaks: How Marie Tharp Revealed the Ocean's Biggest Secret	Jess Keating	4-ESS2 Earth's Systems
Uma Wimple Charts Her House	Reif Larsen and Ben Gibson	4-ESS2 Earth's Systems
Buried Sunlight How Fossil Fuels Have Changed the Earth	Molly Bang and Penny Chisolm	4-ESS3 Earth and Human Activity
Curious Clouds and the CFCs	Michelle Negron Bueno	4-ESS3 Earth and Human Activity
A Race Towards Ozone Recovery	Michelle Negron Bueno	4-ESS3 Earth and Human Activity
Cloudy with a Chance of Meatballs	Judi Barrett	4-ESS3 Earth and Human Activity

Books and Resources Grade 5

Title:	Author:	Unit
Stars Beneath Your Bed: The Surprising Story of Dust	April Pulley Sayre	5-PS1-1
Burn	Darcy Pattison	5-PS1-2
A Rock is Lively	Dianna Hutts Aston	5-PS1-3
What's the Matter in Mr. Whisker's Room?	Michael Elsohn	5-PS1-4
Forces: Physical Science for Kids	Andi Diehn	5-PS2-1
Why Do Elephants Need Sun	Robert E. Wells	5-PS3-1
A Seed is Sleepy	Dianna Hutts Aston and Sylvia Long	5-LS1-1
If Sharks Disappeared	Kate Samworth	5-LS2-1
How Big is Big	Dorothee Soehlke-Lennert	5-ESS1 -1
Boy, Were We Wrong About the Solar System	Kathleen V. Kudlinski	5-ESS1-2
Did a Dinosaur Drink This Water	Robert E. Wells	5-ESS2-1
Rivers of Sunlight: How the Sun Moves Water Around the Earth	Molly Bang and Penny Chisholm	5-ESS2-2
Under Your Feet: Soil, Sand, and Everything Underground	Wenjia Tang	5-ESS3-1

Free Resources and Field Trips for Teachers

Title:	Websites:	Locations:	Contacts:
Adopt a Stream	Adopt a Stream	Midland, Upstate, Columbia area	SCDHEC

3-5-ETS1 Engineering Design

From Seeds to Shoreline	From Seeds to Shoreline	Coastal, All of South Carolina is welcomed to participate.	SC Sea Grant Consortium/ Clemson Extension Contact E.V. Bell

Professional Development

Subject Content:	Provider:	Contacts
Amplify Science Summer Professional Development	Amplify Science	Amplify Science Summer Professional Development