Science Curriculum

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?"

Students are able to identify relationships between the roles of science, technology, and Catholic ethics in the global community and demonstrate stewardship instilled with Catholic values in the care of local and global environments.

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 in formation. Students are expected to use these practices to demonstrate understanding of the core ideas.

Primary Source: Next Generation Science Standards, April, 2013

See www.nextgnscience.org for national science standards and detailed descriptions of cross-cutting concepts, science and engineering practices, flow of core ideas, and ties to Common Core math and language arts standards.

3-5 GRADE CROSS-CUTTING CONCEPTS (to be integrated throughout the curriculum)
Students will:

Patterns –Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.
- Patterns of change can be used to make predictions.
- Patterns can be used as evidence to support an explanation.

Cause and Effect: Mechanism and Prediction –Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

- Cause and effect relationships are routinely identified, tested, and used to explain change.
- Events that occur together with regularity might or might not be a cause and effect relationship.

Scale, Proportion, and Quantity –In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

- Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods,
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Systems and System Models –A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.
- A system can be described in terms of its components and their interactions.

Energy and Matter: Flows, Cycles, and Conservation –Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Matter is made of particles.
- Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.
- Energy can be transferred in various ways and between objects.

Structure and Function–The way an object is shaped or structured determines many of its properties and functions.

- Different materials have different substructures, which can sometimes be observed.
- Substructures have shapes and parts that serve functions.

Stability and Change–For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Change is measured in terms of differences over time and may occur at different rates.

• Some systems appear stable, but over long periods of time will eventually change.
CATHOLIC IDENTITY (to be integrated throughout the curriculum) **Students will:**
ARCHSF-1. Identify relationships between the roles of science, technology, and Catholic ethics in the global community.
ARCHSF-2. Students will be able to demonstrate stewardship instilled with Catholic values in the care of local and global environments.
SCIENTIFIC METHOD (to be integrated throughout the curriculum) **Students will:**
Ask questions and defining problems Form a hypothesis Develop and use models Plan and carry out investigations Analyze and interpret data Construct explanations (for science) and design solutions (for engineering) Obtain, evaluate, and communicate information
ENGINEERING (to be integrated throughout the curriculum) **Students will:**
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.

LIFE SCIENCE LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/ STRATEGIES (**What evidence will demonstrate that students have achieved the Learning outcome)	**BEST PRACTICES**
Students will:		
Classify ways in which living things can be grouped and purposes for different groupings. • Vertebrates – mammals, birds, reptiles, amphibians, and fish • Invertebrates – mollusks, arachnids, sponges, insects, arthropods, and crustaceans	• Use a dichotomous key to classify organisms by their identifying characteristics.	

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.]	• Conduct dissections of a plant (flower) and animal (worm) to identify structures and function of those structures. Create graphic organizers to map the internal and external structures and how each supports survival.	
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.]	• Observe animal interactions. Make t-chart of stimuli and reaction of animals in different situations. (Planet Earth)	

EARTH SCIENCE LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/ STRATEGIES (**What evidence will demonstrate that students have achieved the Learning outcome)	**BEST PRACTICES**
Students will:		
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 indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a	• Model the rock cycle. Identify natural forces at work in creating changing landscape. Compare/contrast landforms and hypothesize processes that created them.	

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.]		
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.]	• Use stream table and change variables to measure the 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.]	• Observe and make models of topographic maps of Earth's surface features.	
Define a mineral and identify minerals based on their properties (e.g., color, luster, hardness, streak).	• Use the Moh's Scale of hardness to differentiate among similar-looking minerals.	
Observe that rock is composed of different combinations of minerals and model the rock cycle. Differentiate sedimentary, metamorphic, and igneous rocks.	• Identify sedimentary, metamorphic and igneous rock samples by characteristics.	
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect	• Create a table from multiple texts that lists renewable/nonrenewable resources, their sources, and their effects on the	

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.]	environment.	
Describe the composition and workings of volcanoes and the causes of earthquakes/tsunamis.	• Research and create a diagram of the parts of volcanoes. Simulate an earthquake that causes a tsunami.	
Analyze maps and other data to determine the likelihood of geological hazards occurring in an area and evaluate the possible effects on landforms and organisms.	• Use New Mexico Natural History Museum resources to collect data about geological hazards.	
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 monitoring of volcanic activity.] [*Assessment Boundary*: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]	• Design and test toothpick towers' ability to withstand simulated earthquakes.	
Identify and describe characteristics of the planets in our solar system.	• Complete research and construct model or other representation of planets.	

PHYSICAL SCIENCE LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/ STRATEGIES (**What evidence will demonstrate that students have achieved the Learning outcome)	**BEST PRACTICES**
Students will:		
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to	• Design an experiment to test how changes	

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.]	in speed affect the energy of an object. Use data and research to explain findings.	
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.	• Conduct a series of experiments documenting the transfer of energy through sound, light, heat and electricity.	
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.]	• Ask questions and predict outcomes of simulated collisions of objects.	
Develop a model using examples to explain differences between renewable and non-renewable sources of energy.	• Venn diagram comparing the differences/similarities in sources of energy.	
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another 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. 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.]	• Use the engineering method to design and construct a solar cooker.	
Design and test a solution to a problem that	• Use the engineering method to design an	

utilizes the transfer of electric energy in the solution using given design constraints.	electrical project.	
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.]	• Use a slinky or rubber band to change the amplitude and wavelength of waves and describe patterns.	
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.]	• Shine light through a convex prism to observe the focusing of light.	
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.]	• Develop two types of codes to compare and contrast information transfer methods.	