PHYSICAL SCIENCE

Energy

Faith Seeking Understanding

- Joshua 6:1-20 (Jericho's walls came tumbling down -- as a result of sound energy)

Catholics making contribution to the topic

- Thomas Bradwardine (c. 1290–1349) – Archbishop of Canterbury and mathematician who helped develop the mean speed theorem

Science outcomes

1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. (Assessment does not include quantitative measurements of changes in the speed of an object or on any precise or quantitative definition of energy.)
2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. (Assessment does not include quantitative measurements of energy.)
3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
    a. Emphasis is on the change in the energy due to the change in speed, not the forces, as the objects interact. (i.e. slower-moving objects have less energy to transfer; faster-moving objects have more energy to transfer)
4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
    a. 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. (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.)

Engineering - Experiments - Extension Activities

- 1,3,4 Design and test a ramp system that will include a rolling ball that goes into a hole in an inverted cup at the base of the ramp, causing the cup to move. Test different elevations of the ramp (causing the ball to roll at different speeds) and mark or measure the differences in the distance that the ball moves the cup.
    - Infer that the faster the ball rolls, the farther it moves the cup, because the ball has transferred more energy to it.
- 2 Use magnifying lenses to concentrate light and focus it on chocolate chips to melt them, to model light transferring to heat energy. *discuss safety of keeping magnifying lenses out of the light when you are not using them, so that they don't start a fire

Crosscutting Concepts

- Religion-
- ELA-cause/effect
- Math-optional: measure distances
- P.E.-kicking or throwing balls with different forces so they go different distances
- Social Studies-

Resources:

- magnifying lenses
- chocolate chips
- balls
- cups
- ramp-making materials (ex. rulers with a groove or long cardboard folded into an upside-down w-shape

to make a trough & something to elevate them)

PHYSICAL SCIENCE

Waves and their Applications in Technologies for Information Transfer

Faith Seeking Understanding

- Actions and visual symbols in Mass and the Sacraments, patterned liturgical responses between the priest/liturgical minister and the congregation

Catholics making contribution to the topic

- Francesco Maria Grimaldi (2 April 1618 – 28 December 1663) was an Italian Jesuit priest who was the first to make accurate observations on the diffraction of light, and coined the term "diffraction". Later scientists used his work as evidence that light was a wave.

Science outcomes

1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
    a. Examples of models could include diagrams, analogies, and physical models using rope to illustrate wavelength and amplitude of waves. Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
    a. Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.
3. Generate and compare multiple solutions that use patterns to transfer information.
    a. Examples of solutions could include drums sending coded information through sound waves, using a coordinate grid and directions with off/on for each box representing black and white to send information about a picture, and using Morse code to send text.

Engineering - Experiments - Extension Activities

- 1. Use a rope to model varying amplitudes and wavelengths. You can have two people hold an end and one shakes it with different amounts of energy. You can have one person lay the rope out on the floor in a straight line, then shake it side-to-side to create differing amplitude and wavelength patterns that can be left visible for students to compare and/or measure.
- 2. Use a closed box with a small hole to look through on one side, and a medium-size hole on the end, and a picture or small object inside the box. With the medium-sized hole covered (no light), look into the small hole. You cannot see the object because no light is present. Uncover the medium-sized hole, look inside, view the object because light is entering the hole, bouncing off the object, and entering your eye. *Extension: allow only a dim amount of light to enter the box, and notice that more light allows you to see better than lesser amounts of light.
- 3. In small groups, have students design multiple signals to communicate basic classroom situational information (ex. need to use restroom, finished work, add on to the discussion's idea vs. share a new idea, need to sharpen a pencil, have a question…) Share ideas. Critique them for feasibility and being non-disruptive communication (don't give these parameters in advance, let the groups be very creative initially). Teacher/group selects one or more to try for a certain time-period and then re-evaluates their effectiveness.

Crosscutting Concepts

- Religion-Sacramental symbols
- ELA-students grouped by sport & creates a demonstration to explain signals related to their sport

• Math-coordinate grid picture based on “off/on” code • P.E.-sports signals (whistles, hand signals, flags, team codes for plays) • Social Studies-drumming, flags, horns, morse-code, smoke-signals to communicate across distances • Other
Resources: • ropes • closed boxes • small objects for inside the box • optional – number/letter grid “off/on” picture* See Appendix.

LIFE SCIENCE

From Molecules to Organisms: Structures and Processes

Faith Seeking Understanding

- Psalm 139: 13-16 (God formed me in my mother's womb, I am fearfully & wonderfully made)

Catholics making contribution to the topic

- Antonio José Cavanilles (16 January 1745 – 5 May 1804) was a leading Spanish taxonomic botanist of the 18th century. He named and classified plants based on their structures.

Science outcomes

1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
    a. Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. Assessment is limited to macroscopic structures with plant and animal systems.
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.
    a. Emphasis is on systems of information transfer. Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.
    b. Examples: dogs use scent, robins hear worm underground, snakes sense heat with their tongues, sharks sense electrical signals from the animals around them, bats use sound (echolocation) to know what is around them

Engineering - Experiments - Extension Activities

- 1-plants: diagram a plant naming its parts and telling their function to help the plant survive, grow, and reproduce. (roots anchor plant & take in water and nutrients; stems transport water, nutrients, and food; leaves make food; petals attract pollinators to assist reproduction; seeds are formed to reproduce; thorns or other defensive structures protect the plant)
- 1-animals: match pictures of animal organs to their functions (heart pumps blood, stomach digests food, lungs obtain oxygen, brain controls body functions, skin protection & sensing)
- 2 sensing scent: simple version-place a container with some strongly-scented item in a hidden location in your classroom while the students are out. Have the class use their sense of smell to locate the hidden object. (ex: onion/garlic, vanilla, etc.) complex version-create containers (such as snack-size zip-close baggies) with cotton balls soaked in a variety of clear scents (vanilla, vinegar, perfume, rubbing alcohol, etc.). Make sets of same-scent containers. Number them all differently so that the teacher will have a master-list of which containers have which scents. Randomly give the scent bags to each student and have them use their sense of smell to find their "scent buddies" to make a group.

Crosscutting Concepts

- Religion-Creation
- ELA-compare/contrast
- Math-
- P.E.-
- Social Studies-
- Other

Resources:

- flowering plant with its root system
- pictures of animals' internal organs

- snack-size zip-close baggies
- cotton balls
- scents
- Animal Senses video http://www.bbc.co.uk/learningzone/clips/senses/2242.html
- Nova Nature video clips

EARTH AND SPACE SCIENCE

Earth's Place in the Universe

Faith Seeking Understanding

- Genesis 1:3-26 (Creation sequence)

Catholics making contribution to the topic

- Coronado discovered the Grand Canyon (Catholic Spanish explorer)

Science outcomes

1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
    a. 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 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 (first, next, then, later, last).

Engineering - Experiments - Extension Activities

- Examine photographs of the Grand Canyon or other rock-layer photos/diagrams with fossils to identify evidence of changes in landscape over time. Realize that lower layers occurred first, and upper layers are more recent.
    - Kansas connections:
        - Sternberg Museum "fish within a fish"
        - limestone in this area contains fossil evidence of mollusks and marine life
        - rock formations with layers
- model rock layers in clear plastic cups – ex. edible version: blue-dyed whipped topping with Swedish fish candy (water), vanilla wafer crumbs with one salad-ready spinach leaf for land plants, Oreo crumbs with gummi worms for topsoil (relate to order of the Creation story in Genesis 1:3-26)

Crosscutting Concepts

- Religion-Creation story
- ELA-sequence of events
- Math-
- P.E.-
- Social Studies-Kansas history/geography, regions
- Other

Resources:

- GoogleMaps "street view" of Grand Canyon on the Colorado River https://www.google.com/maps/views/home?gl=us
- Grand Canyon photographs http://www.nps.gov/grca/index.htm
- Kansas Monument Rocks http://www.naturalkansas.org/monument.htm
- Kansas Travel: Rock Formations http://kansastravel.org/chalkkansas.html
- clear plastic cups
- foods or other materials to model rock layers

EARTH AND SPACE SCIENCE
Earth's Systems
Faith Seeking Understanding • Two Foundations (sand vs. rock) (Matthew 7:24-27)
Catholics making contribution to the topic • Nicholas Steno, Danish Catholic bishop & scientist, founder of modern stratigraphy (rock-layer theory) (beatified in 1988 by Pope John Paul II)
Science outcomes 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. a. 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 is limited to a single form of weathering or erosion. 2. Analyze and interpret data from maps to describe patterns of Earth's features. a. 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.
Engineering - Experiments - Extension Activities • 1 Wind weathering- pan of flour, use a straw to blow with different force across the flour and see the different amounts of weathering it causes. Water erosion-pan of sand, pour water at different amounts or rates, or with the pan angled at different inclinations, to compare effects of erosion. *See Engineering Design for an extension activity based on these concepts. • 2 Analyze a map showing the "Ring of Fire" to recognize that volcanoes and earthquakes occur along the boundaries of tectonic plates. Mountain ranges often occur along these boundaries, as well.
Crosscutting Concepts • Religion-Stewardship of Creation (Genesis 1) • ELA- • Math- • P.E.- • Social Studies-landforms, regions • Other
Resources: • OneGeology site http://www.onegeology.org/extra/kids/home.html • Ring of Fire Map from US National Park Service • https://www.volcanogallery.com/volcano_rofire.htm • Ring of Fire from National Geographic Education http://education.nationalgeographic.com/education/encyclopedia/ring-fire/?ar_a=1 • Ology: Earth http://www.amnh.org/explore/ology/earth • (optional) Wyandotte Water Rally (free field trip opportunity) • (optional) Weathering sorting activity – free on Teachers Pay Teachers http://www.teacherspayteachers.com/Product/FREE-Weathering-Erosion-and-Deposition-Sorting-Activity-354192 • (optional) fieldtrip possibility: Environmental Fair in Topeka at the Kansas History Museum (one day, in

April)

EARTH AND SPACE SCIENCE

Earth and Human Activity

Faith Seeking Understanding

- Stewardship of Creation – Pope John Paul II's encyclical Centesimus Annus "We are not gods, but stewards of the Earth."

Catholics making contribution to the topic

- Sister Paula Gonzalez (born 1932), a Sister of Charity, in the USA. Researcher, activist, and founder of EarthConnection, an environmental learning center, with a focus on renewable-energy technologies for sustainable living.

Science outcomes

1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
    a. Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials (nuclear fission). 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, water pollution from spilled oil.
2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
    a. Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. (limited to earthquakes, floods, tsunamis, and volcanic eruptions)

Engineering - Experiments - Extension Activities

- 1 – Wind power debate OR persuasive letter to the governor of KS about which form of energy Kansas should use to increase its production of electrical power.
    - Wind Power Debate – in teams of 2-4 students, use teacher-provided informational texts about the use of wind energy to create electricity. Half of the groups are assigned to be "for" the use of wind energy, and half of the groups are assigned to be "against" the use of wind energy. Identify supporting evidence and reasons that match your group's opinion. Create a visual or audio presentation to convince others of your position. Optional-host a debate-style presentation of the groups' positions. Class survey for reaction. *See Appendix
    - Persuasive letter to the Governor – Each student (or pair) chooses ONE source of energy that they think Kansas should use more of to increase electricity. Using reasons and supporting evidence from class-activities and research, students explain why their source is environmentally-friendly and works with the natural resources of Kansas, specifically. May be written in a business-letter style format, or as a postcard with a student-drawn picture of their energy source on one side. Really mail it!
- 2 - Given a set of building materials (anything, but the same <u>limited</u> set of materials should be given to each group) students work cooperatively to design a house on a base that will withstand being shaken in a simulated earthquake. All groups' houses are tested. Students use a new set of the same materials to refine their design and attempt to improve its stability/durability during a second earthquake simulation.

Crosscutting Concepts

- Religion- Stewardship of the environment (Genesis & 7th Commandment)
- ELA-persuasive writing; debate; use evidence/examples and reasons to support opinions
- Math-design variables; reason abstractly
- P.E.-

- Social Studies-state government, regional resources and natural earth processes
- Other

Resources:

- multiple student-accessible text sources on renewable and non-renewable energy resources *See Appendix for list of suggested resources
- poster-making supplies (or technology resources such as PowerPoint)
- student-survey of opinions before/during/after Wind Power Debate *See Appendix
- building materials to make a model house, on a flat base
- (optional) fieldtrip possibility: Environmental Fair in Topeka at the Kansas History Museum (one day, in April)

ENGINEERING

Engineering Design

Faith Seeking Understanding

- Two Foundations (sand vs. rock) (Matthew 7:24-27)

Catholics making contribution to the topic

- Nicholas Steno, Danish Catholic bishop & scientist, founder of modern stratigraphy (rock-layer theory) (beatified in 1988 by Pope John Paul II)

Science outcomes

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.
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. 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.

Engineering - Experiments - Extension Activities

- **Prior to this**, complete the "Earth's Systems" lab: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
    - 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 is limited to a single form of weathering or erosion.
- Using what the students have learned about erosion, have them identify an erosion problem in their school/community. Define "criteria for success" and design constraints for the class.
- Have student groups design a possible solution to the erosion problem.
- All groups should share their solution with the class. The class will discuss the pros & cons of each solution, and evaluate it based on how well it is likely to meet the criteria and constraints of the problem. One "best" solution should be identified, and may be modified based on group discussion.
- If possible, the whole class should then work to plan and carry out tests on the planned solution, identifying variables that can be controlled. During and after the tests, students should identify failure points and make adjustments to improve the outcome.
- (optional) Present final solution to the principal or school/parish community through writing or speaking. Examples could include an advertisement for the new program, a letter to the community describing the project, a video-recording of students explaining and implementing the project, or students speaking at a parent meeting, school assembly, or parish committee meeting about the project.

Crosscutting Concepts

- Religion- Stewardship of the environment (Genesis & 7th Commandment)
- ELA-persuasive writing/speaking
- Math-
- P.E.-
- Social Studies-
- Other

Resources:

- materials will vary based on project design