PHYSICAL SCIENCE

Matter and Its Interactions

Faith Seeking Understanding

- Nicene Creed – "God made all things, visible and invisible" Use our senses to observe things that are both visible and invisible, and describe their properties.
- Draw a parallel between the physical conservation of matter and our spiritual immortality "conservation of our soul" because God has made us in his image & likeness, so we have an immortal spirit.

Catholics making contribution to the topic

- Cosmos & Damien – patron saints of chemists

Science outcomes

1. Develop a model to describe that matter is made of particles too small to be seen.
    - Examples of evidence could include adding air to expand a balloon/ball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.
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.
    - Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances. Assessment does not include distinguishing mass and weight.
3. Make observations and measurements to identify materials based on their properties.
    - 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 does not include density or distinguishing mass and weight.
4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Engineering - Experiments - Extension Activities

- #1: Matter is made of particles too small to be seen:
    - Air is invisible because its particles are too small to be seen. We can prove that air is matter with volume/mass by seeing changes that occur when air is added to or taken out of containers. Add air to a balloon or flat ball and see how it expands. Feel air move against your hand as it escapes from an inflated balloon or is squeezed out of a medicine-dropper/syringe.
    - Salt or sugar dissolved in water is invisible (too small to see), but it is still there. You can evaporate the water from it to leave the salt/sugar crystals in the container in a visible form. (combine this with the dissolving lab for #2)
- #2: Conservation of Matter Labs:
    - phase changes – weigh an icecube in a container. Allow it to melt. Weigh again. See that they are the same weight.
    - dissolving – weigh sugar & water separately, dissolve the sugar in the water, weigh again to see that they are the same as the combined weights (remember to include both containers' weight, too!) *Extensions – set sugar water to the side and allow water to evaporate and leave the sugar behind, proving that the sugar is still present even though it was not visible when dissolved. May also hang a string into the water to allow the sugar crystals to gather on it and make "rock candy".
    - chemical changes – weigh each of these objects separately before the chemical change occurs, then weigh the entire system once the chemical change has occurred. Weights should be the same. Sandwich size zip-close baggie with 1 teaspoon of baking soda in it. A 3-oz. cup of

vinegar. Without spilling any of the vinegar, carefully place the cup into the baggie with baking soda so that the cup is standing up inside. Completely seal the baggie, then tip it so that the vinegar spills into the baking soda and observe what happens. *Suggestion – have each small group do this lab to view the chemical change up close, do one whole-group demonstration (You may want to increase the quantities and use a gallon-size bag.) to do the conservation of mass/same weight portion of the lab.

- #3: Closely observe physical properties and describe them. Use these to distinguish between two similar substances. Do at least 4 of the activities below.
    - color – Given a set of objects in the same color family, sort by shades and use specific color word vocabulary (ex. turquoise, not just blue) to describe color differences in similarly-colored objects. *suggested homework: assign beforehand that each student bring a variety of small objects from home of the color that the teacher assigns to them.
    - hardness – scratch several of these items with your fingernail and a metal nail to see if they are affected. Sort them by their hardness. Suggested items to test: clay, penny, quarter, plastic, crayon/wax, sidewalk chalk, wood, graphite from pencil lead, ceramic tile, brick, cement sidewalk, rocks, etc.
    - reflectivity – identify objects that do and don't reflect light. List them in the two categories. Use a flashlight in a dim room to test light reflectivity of items. Suggested items to test: mirror, aluminum foil, rocks, cardboard, water, wood, plastic, cloth, whiteboard, etc.
    - electrical conductivity – make a working simple circuit with a light bulb or motor. Break the circuit in one location near the battery, and use various materials between the battery and the wire to see if the material will conduct electricity and relight/turn on the motor.
    - shape – view salt and sugar crystals under microscope (salt is very cubic, sugar is rough)
    - thermal conductivity tests:
        - two cups of hot water, one with plastic knife & one with metal knife, put a pat of butter on the end of each knife –out of the water- and see that the metal knife conducts heat and melts the butter
        - hot water in a Styrofoam cup and in a metal cup, use your hand on the outside to feel that one allows more heat to be conducted than the other.
    - solubility test: using sugar or salt, mix it into water & see that it dissolves, contrast this with sand when mixed into water (it does not dissolve)
    - response to magnetic forces: aluminum and iron/steel in the presence of a magnet – aluminum with not react, iron/steel will react

Crosscutting Concepts

- Religion-
- ELA-descriptive, precise language, especially adjectives
- Math-conservation of matter relates to decomposing numbers into the addends that make the same sum (ex. 2+8 = 10, 4+6 = 10, etc.)
- P.E.- inflate game balls with invisible air particles
- Social Studies-
- Other – Conservation of matter is a recurring theme, relate this to the food chain/energy cycle lessons in other fifth grade science outcomes.

Resources

- balloons
- sugar or salt

- materials for the conductivity & hardness tests (see details above)
- Styrofoam & metal cups (or thin plastic-use water that is tap-water hot, not boiling)
- sensitive scale, such as one for weighing mail (ask your school or parish office!)
- vinegar
- baking soda
- zip-close baggies (sandwich and gallon sizes)
- Dixie cups (4 oz. size, to hold 3 oz. of vinegar)
- (optional) microscopes, especially "Pocket Microscopes" $10-15 each http://www.specialtyoptical.com/pocketmicroscopeilluminated30xpower.aspx
- (optional) Sandwich Bag Science by Steve Tomecek – available through Scholastic – has the lab sheets for the baking soda & vinegar lab.

PHYSICAL SCIENCE
Motion and Stability: Forces and Interactions
Faith Seeking Understanding • God planned Creation – gravity is a constant that creates predictable results because God gave us an ordered universe. • James 5:8 "Draw near to God, and He will draw near to you." – God draws us to Himself, as gravity draws objects toward Earth. • Colossians 1:17 "He is before all things, and in Him all things hold together."
Catholics making contribution to the topic • Francesco Maria Grimaldi (2 April 1618 – 28 December 1663) was an Italian Jesuit priest who between 1640 and 1650, working with Riccioli, investigated the free fall of objects, confirming that the distance of fall was proportional to the square of the time taken. Grimaldi and Riccioli also made a calculation of the gravitational constant by recording the oscillations of an accurate pendulum.
Science outcomes 1. Support an argument that the gravitational force exerted by Earth on objects is directed down. • Clarification – "down" means toward the center of the Earth. Assessment does not include mathematical representation of gravitational forces.
Engineering - Experiments - Extension Activities • Drop, kick, and throw objects. Observe that they all fall down. On an incline, objects roll/slide down. • Observe a video about space-objects being drawn into Earth's gravitational field and falling (meteors & meteorites, satellites falling to Earth when their trajectory decays, etc.)
Crosscutting Concepts • Religion- • ELA-cause/effect (gravity causes all things to fall down) • Math- • P.E.-objects that are kicked/thrown into the air always fall down. • Social Studies- • Other
Resources: • balls • small objects that can be dropped safely • video about Earth's gravity pulling things toward it Example: Why Doesn't the Moon Fall Down? from "Ask an Astronomer" http://barragreeteaching.com/Grade5/pages/scienceFOLDER/Astronomy/MoonFall.html

PHYSICAL SCIENCE
Energy
Faith Seeking Understanding • Genesis 1:28-30 "I give you every seed-bearing plant all over the earth…for food." (use the full passage from the Bible!
Catholics making contribution to the topic • James Britten – Catholic botanist – head of "Journal of Botany" for 45 years, supported research in plant growth
Science outcomes 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. • Examples of models could include diagrams and flow-charts (especially food chains)
Engineering - Experiments - Extension Activities • Research the food chain that supports an animal. Note that all food chains begin with green plants that make their own food from the sun's energy, or phytoplankton (for ocean food chains) that also make their own food from the sun's energy. • Trace the "energy path" of what you ate at your last meal to give your own body energy. Note that all foods begin as a plant (gets its energy directly from the sun) or an animal that ate plants, which got their energy from the sun.
Crosscutting Concepts • Religion- • ELA-research and present information in a visual display • Math- • P.E.- • Social Studies- • Other - Conservation of matter is a recurring theme, relate this to physical science lessons.
Resources: • research materials for food chains • (optional) Sheppard Software site – Food Chain game http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm

LIFE SCIENCE
From Molecules to Organisms: Structures and Processes
Faith Seeking Understanding • Genesis 1:28-30 "I give you every seed-bearing plant all over the earth…for food." (use the full passage from the Bible!
Catholics making contribution to the topic • James Britten – Catholic botanist – head of "Journal of Botany" for 45 years, supported research in plant growth
Science outcomes 1. Support an argument that plants get the materials they need for growth chiefly from air and water. • Emphasis is on the idea that plant matter comes mostly from air and water, not from soil.
Engineering - Experiments - Extension Activities • Do at least one of these labs: o Sprout a bean in a cup or baggie with a damp paper towel, but no soil. o Grow a water plant in a fishbowl or a bamboo plant in rocks & water. o Root a sweet potato by suspending it above a cup of water. • Watch a video about growing plants hydroponically. An example is listed in the resource section.
Crosscutting Concepts • Religion- • ELA- • Math-measurement & graphing if you track the plants' growth • P.E.- • Social Studies-changes in technology affect the way society gets its food (hydroponics) • Other - Conservation of matter is a recurring theme, relate this to physical science lessons.
Resources: • bean seeds, paper towel, zip-close baggie – lab #1's materials • fishbowl and water plant, or bamboo & container without soil – lab #2's materials • clear plastic cup, toothpicks, sweet potato – lab #3's materials • Hydroponic Lettuce from Discovery Channel's "How It's Made" on YouTube http://youtu.be/FHBhyqowSEc

LIFE SCIENCE
Ecosystems: Interactions, Energy, and Dynamics
Faith Seeking Understanding • Genesis 1:28-30 "I give you every seed-bearing plant all over the earth…for food." (use the full passage from the Bible!)
Catholics making contribution to the topic • James Britten – Catholic botanist – head of "Journal of Botany" for 45 years, supported research in plant growth
Science outcomes 1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.   • 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.
Engineering - Experiments - Extension Activities • Expand a food-chain model to include decomposers and show that decomposed matter in soil is dissolved into water and absorbed by plants. Plants use this, along with carbon dioxide from the air and energy from sunlight, to create food. (When plants do this, it is called photosynthesis-the exact process will be taught more in-depth in middle school.) The food chain becomes a cycle of energy & matter rather than a chain.
Crosscutting Concepts • Religion- • ELA- research and present information in a visual display • Math- • P.E.- • Social Studies- • Other - Conservation of matter is a recurring theme, relate this to physical science lessons.
Resources • research materials for food chains • (optional) Sheppard Software site – Food Chain game http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm • (optional) Sheppard Software site – Decomposers game http://www.sheppardsoftware.com/content/animals/kidscorner/foodchain/decomposers.htm

EARTH AND SPACE SCIENCE

Earth's Place in the Universe

Faith Seeking Understanding

- Genesis 15: 5a "Look up at the sky and count the stars if you can…"
- Psalm 8-10 "O Lord, our Lord...When I see your heavens, the work of your fingers,
  the moon and stars that you set in place---
  What are humans that you are mindful of them,
  mere mortals that you care for them?....
  O Lord, our Lord,
  How awesome is your name through all the earth!"

Catholics making contribution to the topic

- Monsignor Georges Lemaitre – Catholic priest who first discovered what is now called "Hubble's Law" of the expansion of the universe

Science outcomes

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.
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.

Engineering - Experiments - Extension Activities

- Concept #1:
  - Use a flashlight in a dim room. Demonstrate that its light appears brighter and larger when the flashlight is closer to the viewer than it does when the flashlight is across the room. Students can use their hands to encircle the apparent light-source size at three different distances. They should see that the light source appears smaller (and dimmer) when it is farther from them.
- Concept #2:
  - On a sunny day, go outside. Have students stand in one spot and use chalk to trace around their feet. (This will help them return to the same spot later.) Their partner should then trace their shadow. Do this three times: once in early morning, once around noon, and once late in the school day. Students will be able to see the change in direction of the shadow (optional: take a photo of their tracings on the 3rd time) and can use a ruler or tape-measure to measure the length of their shadow each time and record in a table. From the length measurements, they can make a graph of their own data, or do a class-graph using data from each group or averaging the data. If they do their own data graphs, the whole class's graphs could be displayed and discussed to see recurring patterns.
  - day & night – use a flashlight to demonstrate how the sun's light causes day/night when the Earth (globe) turns on its axis
  - Use "sky maps" (planosphere) of constellations to simulate the positions of stars as the seasons change.

Crosscutting Concepts

- Religion-
- ELA-write a narrative of how a constellation came to be (imaginative, make up an explanation for their chosen constellation – similar to Native American origin stories) May introduce by reading aloud "The Seven Brothers" or Micmac's Celestial Bear stories.
- Math-graph appearance of shadows' lengths; describe distances of stars (light years or Angstroms) in exponential form

- P.E.-
- Social Studies-native peoples' stories to explain natural phenomena
- Other

Resources

- flashlight
- globe
- Uncle Al's Star Wheel allows you to print a planosphere for your students to use. http://www.lawrencehallofscience.org/starclock/skywheel.html
- The Most Important Image Captured by Hubble video explains how light from galaxies FAR away that it is invisible to us was captured by the Hubble telescope. http://all-that-is-interesting.com/important-image-captured-by-hubble *note-this video has advertisements before it starts that may or may not be appropriate for student viewing, teachers should load the site and pass the advertisements before displaying for students

EARTH AND SPACE SCIENCE

Earth's Systems

Faith Seeking Understanding

- Stewardship of the earth (Genesis & 7th Commandment)

Catholics making contribution to the topic

- Wengari Muta Maathai – Nobel Peace Prize Laureate, alumnae of Mt. Saint Scholastica in Atchison (now Benedictine College) worked in Kenya to teach native women the importance of planting trees to conserve and improve their environment and sustainability of their farmlands
- Sister Dorothy Mae Stang, S.N.D. – American-born nun who worked in Brazil to improve the lives of the poor and the environment, opposed deforestation of the Brazilian rainforest

Science outcomes

1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
    - Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through water 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 is limited to the interactions of two systems at a time.
2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
    - Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and the polar ice caps, and does not include the atmosphere.

Engineering - Experiments - Extension Activities

- Outcome #1:
    - Model the interaction of the hydrosphere and atmosphere (extension-include the geosphere). Using a large aluminum pan, set a small dish of water to one side (representing a lake/stream/ocean "hydrosphere") and cover the bottom of the pan with a dark piece of construction paper (representing dry land "geosphere"). Place the pan on a flat, horizontal surface outside (warm days preferred). Cover the pan with clear plastic. Allow time for the water to evaporate from the dish and condense on the plastic "atmosphere". You may also be able to observe that this condensed water in the "atmosphere" will fall back to the land "geosphere" if given enough time.
- Outcome #2:
    - Demonstrate the amount of water on Earth compared to the amount of fresh water, compared to the amount of fresh water that is available for use. (see Resources, there are 2 options-"Gulp!" or "How Much Water for Us?") Have students make a circle graph or bar graph to represent the amounts.

Crosscutting Concepts

- Religion-stewardship of the earth (Genesis & 7th Commandment)
- ELA-
- Math-graphing data, percentages, converting volume measurements within a system
- P.E.-
- Social Studies-regions
- Other

Resources

- aluminum pans
- plastic wrap
- water dish
- dark construction paper
- EarthWorks "Gulp!" water proportions demonstration. *See Appendix
- How Much Water For Us? Water proportions – use the Volume model from this site http://www.nrm.qld.gov.au/waterwise/resources/pdf/activities/4_5waterforus.pdf
- containers and measuring tools for water demonstration
- (optional) Sodabottle Science by Steve Tomecek - available through Scholastic – use the "Life in a Bottle" lab to make a terrarium

EARTH AND SPACE SCIENCE
Earth and Human Activity
Faith Seeking Understanding • Stewardship of the environment (Genesis & 7th Commandment)
Catholics making contribution to the topic • Wengari Muta Maathai – Nobel Peace Prize Laureate, alumnae of Mt. Saint Scholastica in Atchison (now Benedictine College) worked in Kenya to teach native women the importance of planting trees to conserve and improve their environment and sustainability of their farmlands • Sister Dorothy Mae Stang, S.N.D. – American-born nun who worked in Brazil to improve the lives of the poor and the environment, opposed deforestation of the Brazilian rainforest
Science outcomes 1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Engineering - Experiments - Extension Activities • Learn about the negative impacts of pollution and using too much of limited resources on an environment. Discuss ways to reduce this problem (reduce, reuse, recycle). Have students identify a specific problem in their community. Students should develop a reasonable solution to this problem. Write a persuasive piece (letter/essay/poster/advertisement/public service announcement) to your community to convince them to recognize and take steps to correct the problem.
Crosscutting Concepts • Religion- Stewardship of the environment (Genesis & 7th Commandment) • ELA-cause/effect; persuasive essay/letter/poster to your community to solve an environmental problem • Math- • P.E.- • Social Studies- • Other
Resources • (optional) Skype another school to discuss ways that they reduce, reuse, and recycle. • (optional) PBS's American Masterpiece "A Fierce Green Fire" video – an hour-long documentary of the environmental movement (teacher should preview & ensure that this is appropriate for your student audience) http://www.pbs.org/wnet/americanmasters/episodes/a-fierce-green-fire/watch-the-film/2924/ • (optional) fieldtrip possibility: Environmental Fair in Topeka at the Kansas History Museum (one day, in April)

ENGINEERING
Engineering Design
Faith Seeking Understanding • Stewardship of the environment (Genesis & 7th Commandment)
Catholics making contribution to the topic • Wengari Muta Maathai – Nobel Peace Prize Laureate, alumnae of Mt. Saint Scholastica in Atchison (now Benedictine College) worked in Kenya to teach native women the importance of planting trees to conserve and improve their environment and sustainability of their farmlands • Sister Dorothy Mae Stang, S.N.D. – American-born nun who worked in Brazil to improve the lives of the poor and the environment, opposed deforestation of the Brazilian rainforest
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 • Build on the "Earth and Human Activity" extension activity for this section. Choose ONE specific problem identified for the school community that all groups will address. Each small group needs to design a solution to the problem that can be implemented using no more than 1 hour of time each week and $100 or less in materials. Specific criteria for success should be identified by the teacher or class before designing begins. 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. 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 earth (Genesis & 7th Commandment) • ELA- persuasive writing/speaking • Math-record costs and ensure that it takes less than 1 hour per week, and $100 or less to implement • P.E.- • Social Studies-community (governmental) organization to solve a community problem, voting process to select a solution to try • Other
Resources: • varies by design solution