

PHYSICAL SCIENCE**Matter and Its Interactions**

Faith supporting Reason

- God is the creator of all matter.
- We must respect all of God's creation starting with the smallest particle of matter.
- Recognize that the equation for a balanced life is to lead a life of stewardship.

Catholics making contribution to the topic

- Fr. Robert Spitzer (1952- present) – Current authority on the origin of the universe from a Catholic perspective. New Book: *New Proofs for the Existence of God: Contributions of Contemporary Physics and Philosophies*
- Jean-Baptiste Dumas (1800–1884) – Chemist who established new values for the atomic mass of thirty elements
- Henri Becquerel (1852–1908) – Awarded the Nobel Prize in physics for his co-discovery of radioactivity
- Fibonacci (c.1170–c.1250) – Popularized Hindu-Arabic numerals in Europe and discovered the Fibonacci sequence
- Fr. Georges Lemaitre (1894-1966) - discoverer of the Big Bang Theory
- Pope Francis (1936-present) Chemical engineer

Science outcomes

1. Develop models to describe the atomic composition of simple molecules and extended structures. (MS-PS1-1)
2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (MS-PS1-2)
3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. (MS-PS1-3)
4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. (MS-PS1-4)
5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. (MS-PS1-5)
6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. (MS-PS1-6)

Engineering - Experiments - Extension Activities

- Fr. Robert Spitzer and Magis Center: Videos on God and modern physics
http://www.magisreasonfaith.org/in_the_beginning.html
- Reuben Margolin: On Kinetic Art, kinetic sculpture videos to tie in math and particle physics
- Mystery pH lab: given various liquids and pH indicator strips determine pH, possible purpose of the solution and try to correctly identify the solution
- Mystery density lab: given different liquid solutions determine which has a greater density
- Make models of elements and compounds using skittles, marshmallows, gummy bears and toothpicks
- Use skittles that represent certain elements to demonstrate balancing equations and the conservation of matter
- Use puzzle pieces that interlock to demonstrate covalent bonding by drawing bonds between elements at the connecting section; ionic bonds are shown by aligning smooth sides of puzzle pieces
- Silver Nitrate and Copper coiled metal to demonstrate displacement reaction and tie in refining of silver through the fire Mal 3:3, Is 48:10, Zec 13:9

Crosscutting Concepts

- Religion- Transubstantiation, Genesis
- ELA- Saint Report with elements connection (Saint Clement is the patron saint of blacksmiths- incorporate iron). Element report discussing simple element building out to more complex molecules and how that element interacts. Non-fiction literature on matter and its interactions
- Math- Balancing equations, solving for variables, graph temperature changes, calculate density, measurement of matter, isotopes and ionic loss and gains, calculating subatomic particles
- P.E.- the thermodynamics behind Olympic curling
- Social Studies- Biographies of scientists, living museum of catholic scientists, infuse with why people settled in areas abundant in certain natural resources

Resources

- Websites: catholiceducation.org, catholiclab.net
- Apps: NOVA Elements, Chemical for balancing equations
- Bible verses: conservation of matter Gen 3:19, All matter was created Gen 2:1-2
- Book: 101 Science Facts and Foreknowledge from the Bible- gives Bible verses for science content
- Catholic Scientists http://en.wikipedia.org/wiki/List_of_Catholic_scientists
http://en.wikipedia.org/wiki/List_of_Roman_Catholic_cleric%E2%80%93scientists

Key content vocabulary: atoms, matter, elements, molecule, compounds, mixtures, protons, neutrons, electrons, nucleus, states of matter, solid, liquid, gas, plasma, boiling point, melting point, freezing point, sublimation, condensation, evaporation, periodic table, group, periods, atomic number, atomic mass, atomic structure, nonmetal, metals, covalent bond, ionic bond, electron shell, valence electron, law of conservation of matter, symbols, yields, subscript, co-efficient, balanced equation, catalyst, inhibitor, endothermic, exothermic, synthesis, decomposition, single replacement, double replacement, combustion, acid-base reaction, solubility, Ph paper, acid, base, hydroxide ion, hydronium ion, blue litmus, red litmus, indicator strip

PHYSICAL SCIENCE
Motion and Stability: Forces and Interactions
Faith supporting Reason <ul style="list-style-type: none"> • Recognize the heavens and the earth obeying the laws of physics • Many forces, like electromagnetism, are present and influence us even though unseen much like the Holy Spirit. • Apply how God created not only matter but forces as well
Catholics making contribution to the topic <ul style="list-style-type: none"> • André-Marie Ampère (1775–1836) – One of the main discoverers of electromagnetism • <u>Galileo Galilei</u> (1564–1642) – Father of modern science • Giovanni Battista Riccioli(1598 –1671) was an Italian astronomer and a Catholic priest in the Jesuit order. He is known, among other things, for his experiments with pendulums and with falling bodies, for his discussion of 126 arguments concerning the motion of the Earth, and for introducing the current scheme of lunar nomenclature. • Bonaventura Cavalieri (1598–1647) – Mathematician known for his work in optics and motion, calculus, and for introducing logarithms to Italy • Jean Buridan (c.1300–after 1358) – French priest who developed the theory of impetus, the first step toward the modern concept of inertia • Francesco Lana de Terzi (1631–1687) – Jesuit priest who has been called the father of aeronautics • Pierre-Simon Laplace (1749–1827) – Famed mathematician and astronomer who has been called the "Newton of France"
Science outcomes <ol style="list-style-type: none"> 1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects. (MS-PS2-1) 2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object. (MS-PS2-2) 3. Apply scientific inquiry to determine the factors that affect the strength of electric and magnetic forces. (MS-PS2-3) 4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (MS-PS2-4) 5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. (MS-PS2-5)
Engineering - Experiments - Extension Activities <ul style="list-style-type: none"> • Reuben Margolin: On Kinetic Art, kinetic sculpture videos to tie in math and particle physics • Magnetic Forces: Build a simple nail electromagnet and study how electric currents create magnetic fields. • Electric fields: Use an extension cord as a jump rope to generate an electrical current. • Newton’s Laws: Assessment- Given a ball, the student will demonstrate all three of Newton’s Laws of motion, marble madness competition to construct a marble track to decrease speed of a marble given certain parameters
Crosscutting Concepts <ul style="list-style-type: none"> • Religion- Perseverance in our work John 5:30 – I Can Do Nothing on My Own, How much force did David have to exert to sling a Xg rock to knock Goliath down?

- ELA- Journal observations and conclusions of experiments
- Math- Calculating vectors, solving for variables for speed, acceleration, distance, work, power, force
- P.E.- Physics of sports
- Social Studies- History of transportation vessels

Resources:

- Books: 101 Science Facts and Foreknowledge from the Bible- gives Bible verses for science content
- Apps: Motion-Simulations by Ravindra Kompella, Force and Motion by Vincent Programing
- Websites: teachengineering.org- couch potato or inertia victim, NASA Magnetism and electromagnetism lessons Center for Science Education berkley.edu, NASA Newton's Laws nasa.gov
- Bible verses: Power: Is 40:26-31, Newton's Laws: Gal 6: 7, Job 4:8, Pro 22:8, When power is received Act 1:8
- Catholic Scientists http://en.wikipedia.org/wiki/List_of_Catholic_scientists
http://en.wikipedia.org/wiki/List_of_Roman_Catholic_cleric%E2%80%93scientists

Key content vocabulary: metric measurement, mass, grams, liters, meters, density, volume, temperature, Celsius, Newton's First, Second, and Third Law of motion, inertia, friction, motion, reference point, speed, velocity, momentum, acceleration, deceleration, gravity, weight, force, balanced and unbalanced forces, newtons, work, Joules, power, watts, Potential Energy, Kinetic Energy

PHYSICAL SCIENCE
Energy

Faith supporting Reason

- Recognize that each person has the potential to bring about the Kingdom of God
- Like energy transforms matter, God transforms us through prayer.
- Focus one's energy to multiply talents that God has given

Catholics making contribution to the topic

- Eugenio Barsanti (1821–1864) – Piarist who is the possible inventor of the internal combustion engine
- Andrew Gordon (Benedictine) (1712–1751) – Benedictine monk, physicist, and inventor who made the first electric motor
- John Polanyi (1929–) – Canadian chemist who won the 1986 Nobel Prize for his research in chemical kinetic

Science outcomes

1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (MS-PS3-1)
2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. (MS-PS3-2)
3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (MS-PS3-3)
4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (MS-PS3-4)
5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (MS-PS3-5)

Engineering - Experiments - Extension Activities

- Thermal Energy Transfer: build/ design solar ovens or ice cube insulators
- Transfer of energy: build/design a roller coaster demonstrating kinetic and potential energy, marble madness competition to construct a marble track to decrease speed of a marble given certain parameters, mouse trap powered car with energy held in springs with the objective of extending the transfer of energy to allow for the car to travel the farthest, charge a plastic grocery bag to create potential energy that transfers to kinetic when a hand is placed near.

Crosscutting Concepts

- Religion-Conservation of energy/ Transfer of energy: Reflect on where you are placing your focus and energy within your daily spiritual life. 1 Cor 12:6
- ELA- Non-fiction literature on Energy using readworks.org
- Math- Measure temperature, adding integers, calculating calories
- P.E.- Physics of sports
- Social Studies- Benjamin Franklin and the transfer of energy, geothermic and hydroelectric power sources

Resources:

- Book: 101 Science Facts and Foreknowledge from the Bible- gives Bible verses for science content
- Apps: Coaster Physics by Ziconic,
- Websites: readworks.org- Search “Reading Passages” for topic on Energy, Dept of Energy <http://www.energy.gov/>,
- Bible Verses: 1 Cor 12:6 , Energy Phil 2: 13-23,

- Catholic Scientists http://en.wikipedia.org/wiki/List_of_Catholic_scientists
http://en.wikipedia.org/wiki/List_of_Roman_Catholic_cleric%E2%80%93scientists

Key content vocabulary: Conduction, convection, radiation, Conservation of energy, potential and kinetic energy, mass, speed, acceleration, thermal energy, energy transfer, types of energy, heat, temperature, Celsius, fusion, fission

PHYSICAL SCIENCE
Waves and Their Applications in Technologies for Information Transfer
Faith supporting Reason <ul style="list-style-type: none"> • Like the standardized patterns in a wave, God has a plan for our lives • Understand that Jesus is the light of the world. Whoever follows Him will never walk in darkness. Jn 8:12 • God’s mercy flows in wave after wave on those who are in awe before Him. Lk 1:50
Catholics making contribution to the topic <ul style="list-style-type: none"> • Francesco Maria Grimaldi (1618–1663) – Jesuit who discovered the diffraction of light • Étienne-Louis Malus (1775–1812) – Discovered the polarization of light • Guglielmo Marconi (1874–1937) – Father of long-distance radio transmission • Christopher Clavius (1538–1612) – Jesuit who was the main architect of the Gregorian calendar • <u>René Descartes</u> (1596–1650) – Father of modern philosophy and analytic geometry • Giuseppe Mercalli (1850–1914) – Priest, volcanologist, and director of the Vesuvius Observatory who is best remembered today for his Mercalli scale for measuring earthquakes which is still in use • Marin Mersenne (1588–1648) – Minim philosopher, mathematician, and music theorist who is often referred to as the "father of acoustics" • Jozef Murgaš (1864–1929) – Priest who contributed to wireless telegraphy and help develop mobile communications and wireless transmission of information and human voice • Saint Lucy (283–304) - Saint of light
Science outcomes <ol style="list-style-type: none"> 1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. (MS-PS4-1) 2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. (MS-PS4-2) 3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (MS-PS4-3)
Engineering - Experiments - Extension Activities <ul style="list-style-type: none"> • Using a slinky, rope and dominos demonstrate different wave patterns • Use the example of popcorn transforming from a kernel when introduced to a radio wave • Investigate how water can refract light waves and change the perception of an object’s location • Use prisms to explore what makes up light waves • Demonstrate the Doppler effect by listening to a sound in motion
Crosscutting Concepts <ul style="list-style-type: none"> • Religion- Liturgical calendar and its pattern of highs in Easter and lows in Lent • ELA- Relate the ups and downs of a plot diagram from a story to the rise and fall of a wave • Math- Use integers to calculate amplitudes of waves when two waves collide • P.E.- Use a parachute to demonstrate waves and see how waves can combine • Social Studies-Tsunami and earthquake wave patterns affects on the land, the history of radio waves in supporting the transfer of information, design of amphitheaters to increase sound waves for optimal audience experience
Resources: <ul style="list-style-type: none"> • Book: <u>101 Science Facts and Foreknowledge from the Bible</u>- gives Bible verses for science content,

Take Home Physics: 65 High-Impact, Low Cost Labs contains labs that use ordinary household items or other inexpensive materials to tackle motion and kinematics; forces and energy; waves, sound, and light; and electricity and magnetism

- Websites: <http://www.spaceandmotion.com/science-physics-wsm-wave-diagrams.htm>,
<http://www.physicsclassroom.com/class/sound>
- Apps: Ripple Tank by Java, Doppler Effect in Sound by Designmate,
- Bible Verses: Mi 7:8, Mt 5:14, Pb 4:18
- Catholic Scientists http://en.wikipedia.org/wiki/List_of_Catholic_scientists
http://en.wikipedia.org/wiki/List_of_Roman_Catholic_cleric%E2%80%93scientists

Key content vocabulary: wave, amplitude, crests, troughs, types of waves, reflected, absorbed, transmitted, refracted, compression, analog signals, encode, transmit, Doppler, electricity, magnetism, vibration, spectrum, conductor, insulator, pole