Fall 2016

Diocese of Green Bay
Science Standards

In the study of science students learn through natural curiosity about the world God created for us. Learning scientific principles occurs through careful observation and experimentation. Students have the privilege of learning about God's creation from a Catholic perspective leading to responsible stewardship and ultimate respect and love for the Creator. The study of God's creation and how we interact with the world, emphasizes the dignity and sacredness of life in all forms. Students learn to take responsibility for their actions and to be good stewards of God's creation.

The science standards and benchmarks are based on the Next Generation Science Standards which provide a strong foundation in science and technology education. These standards have refocused K-12 science education on big ideas and first hand experiences such as observation, investigation, design, and modeling to help students make meaningful connections to science and life.

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References and Resources

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Catechism of the Catholic Church

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A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. National Research Council of the National Academies. The National Academies Press. Washington, D.C. (2012)
Next Generation Science Standards

Science as Inquiry

Sixth Grade, Seventh Grade, Eighth Grade

Students with understanding will:

1. Share how the beauty and goodness of God is reflected in nature and the study of the natural sciences.
2. Investigate contributions to the advancement of science made by people in the Catholic church, different cultures, and at different times in history.
3. Distinguish the difference between the use of the scientific method and the use of theological inquiry to know and understand God's creation and universal truths.
4. Apply Catholic values, morals and ethics to the development and application of science concepts.
5. Trace the development of an invention, theory, or discovery to demonstrate the dynamic nature of science.
6. Identify key Catholic scientists such as Copernicus, Mendel, DaVinci, Bacon, Pasteur, Volta, St. Albert the Great, and others and the witness and evidence they supply against the false claim that Catholicism is not compatible with science

10. Use appropriate mathematics with data to construct reasonable explanations.
11. Communicate about observations, investigations and explanations.
12. Review and ask questions about the observations and explanations of others.
13. Work in collaboration with others on scientific investigations.
14. Read like a scientist: cite textual evidence when summarizing broad ideas and analyzing text, integrate information graphically, and compare and contrast information gained from multimedia sources and experiments.
15. Write like a scientist: write arguments focused on science content, perform short focused research projects in response to a question or problem, and gather relevant information from multiple print and digital sources paraphrasing and citing to avoid plagiarism.

7. Observe and ask questions about the natural world God created. 8. Plan and conduct simple investigations individually and with a team. 9. Employ simple equipment and tools to gather data and extend the senses.	

Physical Science Sixth, Seventh, and Eighth Grade	
Matter and Its Interactions	
Structure and Properties of Matter (SP)	*Students with understanding will:* 1. Maintain that all earth's substances come from God. 2. Explain how substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. 3. Develop the historical perspective of the atomic and molecular theory. 4. Examine, describe, compare, measure, and classify objects based on physical and chemical properties. 5. Compare and contrast the characteristics of particles in a solid, liquid, and a gas. 6. Differentiate how all matter is composed of atoms, consisting of protons, neutrons, and electrons. 7. Classify and describe matter in terms of elements, compounds, mixtures, atoms and molecules 8. Demonstrate that a pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. 9. Compare and contrast the characteristics of particles in a solid, liquid, and a gas.

	10. Examine that in a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. 11. Analyze how solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). 12. Model how molecules form based on the patterns in the periodic table 13. Summarize the changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. 14. Draw conclusions from information about how synthetic materials come from natural resources and their impact on society. 15. Develop models to describe the atomic composition of simple molecules and extended structures . 16. Develop a model, drawing, diagram that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
Chemical Reactions (CR)	*Students with understanding will:* 1. Observe, describe, and identify changes in properties based on chemical reactions. 2. Describe a chemical process (atoms are regrouped into different molecules). 3. Compare and contrast the properties of an original substance and the new substance following a chemical process. 4. 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 5. Demonstrates understanding of the Law of Conservation of Matter. 6. Describe how some chemical reactions release energy, others store energy 7. Describe how natural resources undergo a chemical process to form synthetic material.

Energy (E)	*Students with understanding will:* 1. Distinguish “heat” as both thermal energy and the transfer of that thermal energy from one object to another. 2. Describe qualitative and quantitative relationships of energy transfer and energy transformation using data, observations, and graphs. 3. Demonstrate how adding or removing thermal energy to solids, liquids, or gases, increases or decreases kinetic energy of the particles until a change of state occurs. 4. Investigate fluid pressure in terms of speed and temperature. 5. Develop a model that predicts and describes changes in particular motion, temperature, and state of a pure substance when thermal energy is added or removed. 6. Conduct an experiment and collect data to support the law of conservation of thermal energy. 7. Design a project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
Motion and Stability: Forces and Interactions	
Forces and Motion (FM)	*Students with understanding will:* 1. Articulate Newton’s First, Second, and Third Law of Motion and provide examples of each. 2. Design a solution to a problem to demonstrate the varying responses of two colliding objects. 3. Investigate the motion of objects and collect and analyze data to explain changes in motion in terms of unbalanced forces.
Types of Interactions (TI)	*Students with understanding will:* 1. Describe how magnetic field strength changes with distance. 2. Design an experiment using a magnet or a compass to demonstrate magnetic fields. 3. Develop a testable question and design an experiment to determine factors that can influence the strength of electromagnetic forces between interacting objects. (magnitude of charges, currents, strengths, distance. 4. Construct and defend argument on gravitational forces using data collected.

	5. Collect data related to strength of interactions, distance from the sun, or orbital periods of objects in the solar system. 6. Apply an understanding of magnetic fields to magnetic fields in outer space.
Energy	
Types of Energy	*Students with understanding will:* 1. Conduct an experiment and display collected data to show the relationship between mass, energy , and speed. 2. Describe different types of potential energy. 3. Describe different types of kinetic energy. 4. Develop a model to explain the relationship between a. distance and gravitational potential energy (i.e., roller coaster at varying position on a hill or objects at varying heights on shelves) b. distance and magnetic potential energy (i.e., changing the direction/orientation of a magnet) c. distance and electrical potential energy (i.e., a balloon with static electric charge brought closer to another's hair) 5. Demonstrate kinetic energy as proportional to the mass of the moving object and grows with the square of its speed. 6. Design and test a device that supports a prediction of the insulating properties of materials. 7. Plan an investigation that compares initial and final temperatures of an isolated variable: a. same mass of different materials b. different mass of the same material c. same mass of same material in different environment 8. Recognize that energy is not lost, but changes forms. 9. Explain how kinetic energy is transferred based on an experiment in which objects move. 10. Describe the relationship between temperature and how the total energy of a system depends on the types, states, and amounts of matter present. 11. Trace the changes in forms and types of energy in a closed system (i.e., swinging pendulum, spring, rubber band, bow and arrow)

	12. Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
Waves and Their Applications in Technologies for Information Transfer	
Wave Properties	*Students with understanding will:* 1. Explain simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. 2. Differentiate between three types of waves 3. Observe and demonstrate that sound is affected by the matter through which it travels. 4. Describe how sound waves travel. 5. Demonstrate how the ear is a receptor of sound. 6. Identify the difference between analog and digital signals. 7. Explain why digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.
Electromagnetic Radiation	*Students with understanding will:* 1. Identify visible light as one component of the electromagnetic spectrum. 2. Observe and demonstrate when light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. 3. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. ' 4. Investigate the reflection of light with mirrors and refraction of light with lenses. 5. Investigate a wave model of light to explain brightness, color, and the frequency-dependent bending of light at a surface between media. 6. Explain how light can travels through space.

Life Science Sixth, Seventh, and Eighth Grade	
Molecules to Organisms (M)	
Structures and Processes	*Students with understanding will:* 1. Articulate the Catholic church belief, through faith, that God created "freely out of nothing" and God needs no pre-existent thing or any help in order to create (CCC 296, 297). 2. Investigate contributions to the advancement of life science made by scientists in the Catholic church, different cultures, and at different times in history. 3. Provide evidence that all living things are made up of cells which is the smallest unit that can be said to be alive. 4. Distinguish differences between single-celled and multicellular organisms. 5. Develop a model to describe the structure and function of different parts of a cell. 6. Demonstrate how parts of the cell work together to provide energy for life processes. 7. Compare and contrast a variety of body structures/ systems within organisms, plants and animals, and their role for survival. 8. Describe how systems of the body work together, but are also specialized for particular body functions. 9. Represent the relationship between the levels of organization in living things: cells, tissues, organs, systems. 10. Recognize an organism's behavioral and physical adaptations

Growth and Development of Organisms **(O)**	*Students with understanding will:* 11. Provide examples of behaviors that affect the probability of animal reproduction. 12. Analyze the impact of animal behaviors and specialized features that affect the probability of plant reproduction 13. Construct a scientific explanation for how environmental and genetic factors influence the growth of organisms. 14. Identify ethical standards relating to scientific research and investigation in regards to working with living organisms.
Organization for Matter and Energy Flow **(ME)**	*Students with understanding will:* 15. Represent and explain the chemical process of photosynthesis. 16. Represent the relationship between photosynthesis and respiration. 17. Identify the process and chemical reactions through which food moves to form new molecules, to support growth, or to release energy.
Information Processing **(IP)**	*Students with understanding will:* 18. Describe how different types of neurons work together to transmit information to and from the brain/spinal cord.

Ecosystems: Interactions, Energy and Dynamics	
Interdependent Relationships in Ecosystems **(RE)**	*Students with understanding will:* 1. Describe the interactions of organisms and populations of organisms with other living things and with nonliving factors. 2. Recognize the competition of limited resources (food, water, oxygen…) among organisms in an environment and analyze the effects on growth and reproduction. 3. Identify and classify symbiotic relationships. 4. Identify predatory interactions that may reduce of organisms or eliminate whole populations of organisms. 5. Describe the eight biomes in terms of their distinct biotic and abiotic characteristics 6. Compare and contrast the pattern of interactions between organisms in varying environments
Cycle of Matter and Energy Transfer in Ecosystems **(CM)**	*Students with understanding will:* 7. Describe how plants are producers 8. Develop a model of a food web that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem.
Ecosystem Dynamics, Functioning, and Resilience	*Students with understanding will:* 9. Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

(ED)	10. Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)
Biodiversity and Humans	*Students with understanding will:* 11. Explain how changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5) 12. Explain the processes of conservation, preservation, overconsumption, and stewardship as it relates to creation and to caring for one another and for all that God has give to sustain and delight us.
Heredity: Inheritance and Variation of Traits (H)	
Growth and Development of Organisms **(GD)**	*Students with understanding will:* 1. Organisms reproduce, sexually or asexually, and transfer their genetic information to their offspring. 2. Understand the Catholic teaching on human sexuality and respect for all life.
Inheritance of Traits **(IT)**	*Students with understanding will:* 3. Relate how the human soul is specifically created by God for each human being, does not evolve from lesser matter, and is not inherited from our parents. 4. Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. 5. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)

	6. Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) 7. Relate heredity and reproduction to Catholic teachings. 8. Demonstrate an understanding of the moral issues and Church teachings regarding work in the areas of *in vitro* fertilization, human cloning, human genetic manipulation, and human experimentation.
Variation of Traits	*Students with understanding will:* 9. In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) 10. In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1) 11. Subscribe to the premise that nature should not be manipulated at will, but should be respected for its natural purpose and end as destined by the creator God.
Biological Evolution	
Evidence of Common Ancestry and Diversity	*Students with understanding will:* 1. Analyze and articulate the Catholic teaching about the origin of life and the theory of evolution. 2. The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) 3. Compare and contrast anatomical similarities and differences between various organisms living today and organisms in the fossil record.

	4. Enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) 5. Compare the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)
Natural Selection	*Students with understanding will:* 6. Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) 7. In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5)
Adaptations	*Students with understanding will:* 8. Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

Earth and Space Sixth, Seventh, and Eighth Grade	
Earth's Place in the Universe (E)	
The Universe and Its Stars	*Students with understanding will:* 1. Articulate a deep sense of wonder and delight about the natural universe. 2. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) 3. Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe all created by God, the master Creator. (MS-ESS1-2)
Earth and the Solar System	*Students with understanding will:* 4. The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MSESS1-3) 5. This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) 6. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

The History of the Planet Earth	*Students with understanding will:* 7. The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4) 8. Tectonic processes continually generate new ocean sea floor at ridges and destroy old seafloor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3)
Earth's Systems	
Earth's Materials and Systems	*Students with understanding will:* 1. All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) 2. The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)
Plate Tectonics and Large-scale System Interactions	*Students with understanding will:* 3. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

Role of Water in the Earth's Processes	*Students with understanding will:* 4. Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) 5. The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MSESS2-5) 6. Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) 7. Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) 8. Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)
Weather and Climate	*Students with understanding will:* 9. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) 10. Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) 11. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)
Earth and Human Activity	
Natural Resources	*Students with understanding will:* 12 Articulate that humans were given the great gift of the earth and depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. 13. Analyze why minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

	14. Share how natural phenomena have more than a utilitarian meaning and purpose and exemplify the handiwork of the Creator.
Natural Hazards	*Students with understanding will* 15 Map the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)
Human Impacts on Earth Systems	*Students with understanding will:* 16 Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS- ESS3-3) 17. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MSESS3-3),(MS-ESS3-4) 18. Share concern and care for the environment as part of God's creation.
Global Climate Change	*Students with understanding will:* 19. Human activities, such as the release of greenhouse gases from burning fossil fuels, are factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)