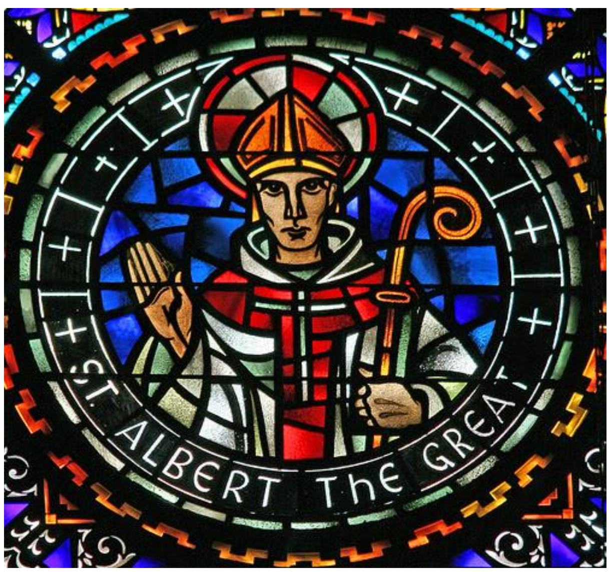
ELEMENTARY
AND
MIDDLE SCHOOL

SCIENCE STANDARDS
K-8



Patron Saint of Scientists

Catholic Schools Office
Diocese of Tucson
2015

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SCIENCE STANDARDS

Diocese of Tucson

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The Department of Catholic Schools of the Diocese of Tucson expresses gratitude to the Science Standards Committee for their hard work and dedication to this process. These standards are based on the work of the Diocese of Phoenix Science Committee and not only will challenge our students in learning science but are reflective of core Catholic beliefs. Science provides an important perspective for looking at the world within our Catholic values.

These standards stress student inquiry, critical thinking and questioning, open-minded investigation and reflective practices. These standards are designed to inspire our students to be curious, to explore and to increase their depth of learning. We want our students to be challenged with rigorous standards infused with faith. We are forming students to solve problems, think deeply and critically and make informed, scientifically literate decisions rooted in Catholic teaching and moral responsibility so that they are well equipped to face the world.

Special Acknowledgments:

The Catholic Schools Office would like to express deepest gratitude to the **Diocese of Phoenix** for sharing the work they did on the science standards. The Diocese of Tucson standards are based upon the standards of the Diocese of Phoenix.

Thank you to **Rose Raderstorf**, 5th grade teacher at Santa Cruz Catholic School for her work on infusing Catholic Social Teaching into the standards. Her dedication to this project is admirable and most appreciated. This document begins on page 8.

SCIENCE
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2014-2015

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Diocese of Tucson Science Standards K-12
Philosophy Statement

The universe is a place subject to fundamental scientific principles. An understanding of these principles will better prepare an individual to cope with a world in which rapid technological developments are taking place. As knowledge rapidly expands, it is most important for students to learn to make rational and moral decisions based upon scientific principles and their Catholic values. The skills and knowledge afforded students to make these types of decisions should reflect an appropriate level of intellectual and emotional growth. These standards are designed to stimulate curiosity and to develop morally responsible, scientifically literate citizens. These standards stress the process of science as a way of learning and further emphasize that scientific knowledge is always subject to change based on additional knowledge.

Goals

All students will:

1. Develop interest, wonder, and curiosity about the study of the universe while recognizing the objective nature of science as created by God.

2. Develop responsible Catholic decision making skills in matters related to science and technology's impact on society with respect for the environment and all living things.

3. Recognize that science integrates mathematics, reading, oral and written communication, which are influenced by religious beliefs.

4. Develop an understanding of the processes and skills necessary for scientific investigation, problem solving, and critical thinking.

5. Develop an understanding of the scientific process and the structure of science, which includes organizing data into facts, principles, models, laws, and theories.

6. Realize the practical application of science in everyday life through technology and engineering.

Explanation of Engineering Standards

These standards should be considered by teachers when lesson planning and integrated into lessons as seen fit along the way. They are not to be approached as separate from the curriculum but connected in a natural way. The goal is to embed a deep understanding of each of the ETS standards within students for each section (K-2, 3-5, 6-8) by the end of each three year cycle.

National Standards and Benchmarks for effective Catholic Elementary and Secondary Schools
March 2012

Academic Excellence:

The United States Conference of Catholic Bishops affirms the message of the Congregation on Catholic Education that intellectual development of the person and growth as a Christian go forward hand in hand. Rooted in the mission of the Church, the Catholic school brings faith, culture and life together in harmony. In 2005, the bishops noted that "young people of the third millennium must be a source of energy and leadership in our church and our nation. And, therefore, we must provide young people with an academically rigorous and doctrinally sound program of education" *(Renewing Our Commitment to Catholic Elementary and Secondary School is in the Third Millennium, 2005).*

The essential elements of "an academically rigorous and doctrinally sound program" mandate curricular experiences-including co-curricular and extra-curricular activities-which are rigorous, relevant, research-based, and infused with Catholic faith and traditions. The following essential elements provide a framework for the design, implementation, and assessment of authentic academic excellence in Catholic school education from pre-kindergarten through secondary school.

Standard 7: An excellent Catholic school has a clearly articulated, rigorous curriculum aligned with relevant standards, 21st century skills, and Gospel values, implemented through effective instruction. *BENCHMARKS:*

7.1	The curriculum adheres to appropriate, delineated standards, and is vertically aligned to ensure that every student successfully completes a rigorous and coherent sequence of academic courses based on the standards and rooted in Catholic values.
7.2	Standards are adopted across the curriculum, and include integration of the religious, spiritual, moral, and ethical dimensions of learning in all subjects.
7.3	Curriculum and instruction for the 21st century learning provide students with the knowledge, understanding and skills to become creative, reflective, literate, critical, and moral evaluators, problem solvers, decision makers, and socially responsible global citizens.
7.4	Curriculum and instruction for 21st century learning prepares students to become expert users of technology, able to create, publish, and critique digital products that reflect their understanding of the content and their technological skills.
7.5	Classroom instruction is designed to intentionally address the effective dimensions of learning, such as intellectual and social dispositions, relationship building, and habits of mind.
7.6	Classroom instruction is designed to engage and motivate all students, addressing the diverse needs and capabilities of each student, and accommodating students with special needs as fully as possible.
7.7	Faculty collaborates in professional learning communities to develop, implement and continuously improve the effectiveness of the curriculum and instruction to result in high levels of student achievement.
7.8	The faculty and professional support staff meet (arch) diocesan, state, and/or national requirements for academic preparation and licensing to ensure their capacity to provide effective curriculum and instruction.
7.9	Faculty and professional support staff demonstrate and continuously improve knowledge and skills necessary for effective instruction, cultural sensitivity, and modeling of Gospel values.
7.10	Faculty and staff engage in high quality professional development, including religious formation, and are accountable for implementation that supports student learning.

Standard 8: An excellent Catholic school uses school-wide assessment methods and practices to document student learning and program effectiveness, to make student performances transparent, and to inform the continuous review of curriculum and the improvement of instructional practices. BENCHMARKS:

8.1	School-wide and student data generated by a variety of tools are used to monitor, review, and evaluate the curriculum and co-curricular programs; to plan for continued and sustained student growth; and to monitor and assess faculty performance.
8.2	School-wide and aggregated student data are normed to appropriate populations and are shared with all stakeholders.
8.3	Faculty use a variety of curriculum-based assessments aligned with learning outcomes and instructional practices to access student learning, including formative, summative, authentic performance, and student self-assessment.
8.4	Criteria used to evaluate student work and the reporting mechanisms are valid, consistent, transparent, and justly administered.
8.5	Faculty collaborates in professional learning communities to monitor individual and class-wide student learning through methods such as common assessments and rubrics.

Standard 9 An excellent Catholic school provides programs and services aligned with the mission to enrich the academic program and support the development of student and family life. BENCHMARKS*:*

9.1	School-wide programs for parents/guardians provide opportunities for parents/guardians to partner with school leaders, faculty, and other parents/guardians to enhance the educational experiences for the school community.
9.2	Guidance services, wellness programs, behavior management programs, and ancillary services provide the necessary support for students to successfully complete the school program.
9.3	Co-curricular and extra-curricular activities provide opportunities outside the classroom for students to further identify and develop their gifts and talents and to enhance their creative, aesthetic, social/emotional, physical, and spiritual capabilities.

Introduction

Science teachers as Moral Educators

The introduction of ethics in science classes is not the only way to portray science. It is an effective method, and it places science in the context in which it actually operates in society. In addition, the very methods of inquiry and standards of public reasoning that science advances can make a valuable contribution to the moral education of students, beginning when the study of science begins, even at the youngest grades.

Although ethical questions cannot be answered by science alone it seems clear that a reasonable approach to an ethical question requires carefully attending to, and seeking out, all of the relevant facts.* We strive to seek God in all things, recognizing parents as the primary moral educators of their child. **

*Michael S. Pritchard http://www.onlineethics.org/CMS/edu/precol

**The Catechism of the Catholic Church #2221

Diocese of Tucson
Next Generation Science Standards
Catholic Social Teaching (CST) and Catholic Identity Correlations
Kindergarten through High School

-Rose Raderstorf

Section I: Kindergarten-5th Grade

KEY (for K-5)

NGSS Abbreviation	Topical Arrangement	- NGSS standard in original form and highlighted in yellow followed by a suggested Catholic Identity connection (t*he theme of Catholic Social Teaching that the suggestion could possibly address is written in italics)*

Kindergarten

K-PS2	Motion and Stability: Forces and Interactions	- KPS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object and introduce procedures for investigations in the context of respecting each other's *human dignity*. - Emphasize proper use of resources and materials through the lens of *stewardship of the Earth*.
K-PS3	Energy	- K-PS3-1: Make observations to determine the effect of sunlight on Earth's surface and discuss how the energy from Earth's sunlight is a gift from God - K-PS3-2: Create a structure to reduce the warming effect of sunlight on an area with the goal of creating something to protect the homeless in Tucson (*preferential option for the poor)*
K-LS1-1	From Molecules to Organisms: Structures and Processes	- K-LS1-1: Use observations to describe patterns of what plants and animals (including humans) need to survive and use these observations to create a list of ways the class can make sure they are good *stewards of the earth* who don't interrupt these patterns (i.e. how can we make sure all living things in our school get water)
K-ESS2	Earth's Systems	- K-ESS2-2: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs and discuss the ways that humans have changed the environment in good and bad ways (*stewardship of the earth)*
K-EES2	Earth and Human Activity	- Discuss how plants and animals are connected to humans and how we all rely on each other as part of God's creation - K-EES3-1: Use a model to represent the relationship between the needs of different plants or animals and the places they live with the goal of emphasizing that we are all stewards of each other's environments (*stewardship of the earth)*

First Grade

1-PS4	Waves and their Applications in Technologies for Information Transfer	- 1-PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate and introduce procedures for investigations in the context of respecting each other's *human dignity*. - Emphasize proper use of resources and materials through the lens of *stewardship of the Earth*. - 1-PS4-4: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance with the goal of creating a device that would make a worker at the school's job easier (*dignity and rights of workers* and *the call to family, community, and participation)*
1-LS1	From Molecules to Organisms: Structure and Processes	- 1-LS1-1: Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs with the goal of designing something to protect construction or utility workers (*dignity and rights of workers* and *the call to family, community, and participation)*
1-LS3	Heredity: Inheritance and Variation of Traits	- 1-LS3-1: Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents with a focus on how we are all connected to and should be supportive parts of our families (*call to family, community, and participation)*
1-ESS1	Earth's Place in the Universe	- Use observations of the patterns in our universe to express wonder and awe for the way God designed our universe

Second Grade

2-PS1	Matter and its Interactions	- 2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of material by their observable properties and introduce procedures for investigations in the context of respecting each other's *human dignity*. - Emphasize proper use of resources and materials through the lens of *stewardship of the Earth*.
2-LS2	Ecosystems: Interactions, Energy, and Dynamics	- 2-LS2-1: Plan and conduct an investigation to determine if plants need sunlight and water to grow and use the results of the investigation to have a discussion on ways 2nd graders can practice *stewardship of the earth* and help plants have the resources they need to grow.
2-LS4	Biological Evolution: Unity and Diversity	- 2-LS4-1: Make observations of plants and animals to compare the diversity of life in different habitats and connect these observations to a discussion on the diverse ways God created all plants and animals (including humans).

2-ESS1	Earth's Place in the Universe	- 2-ESS1-1: Use information from several sources to provide evidence that Earth events can occur quickly or slowly with the goal of creating a help guide with warning signs for people who live near dangerous areas (i.e. earthquake zones) (*the call to family, community, and participation)*
2-ESS2	Earth's Systems	- 2-ESS2-1: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land and connect these solutions to why we need to protect our Earth (*stewardship of the earth)*

Third Grade

3-PS2	Motion and Stability: Forces and Interactions	- 3-PS2-4: Define a simple design problem that can be solved by applying scientific ideas about magnets and connect the design to something that will benefit the school (i.e. a latch that keeps the outside recycling or trash cans shut to keep materials from going all over the school grounds) (*stewardship of the earth, dignity and rights of workers)* - Emphasize proper use of resources and materials through the lens of *stewardship of the Earth*.
3-LS1	From Molecules to Organisms: Structures and Processes	- 3-LS1-1: Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death and connect these models to a discussion on the diverse ways God created all organisms.
3-LS2	Ecosystems: Interactions, Energy, and Dynamics	- 3-LS2-1: Construct an argument that some animals form groups that help members survive and connect this argument to the ways that humans work together to survive and help struggling members OR the ways that humans can learn to be better community members from these animal groups (*the call to family, community, and participation).*
3-LS3	Heredity: Inheritance and Variation of Traits	- 3-LS3-2: Use evidence to support the explanation that traits can be influenced by the environment with an emphasis on our responsibility to make sure our environment is a healthy place for humans, animals, and other organisms to grow (*rights and responsibilities, stewardship of the earth)*
3-LS4	Biological Evolution: Unity and	- 3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all with a focus on the uniqueness

	Diversity	every creature created by God brings and the respect each of us deserve within our own environments (*respecting human dignity)* - 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change and emphasize our responsibility to limit the number of changes we cause to the environment as well as our responsibility to come up with solutions to the changes that are inevitably caused (*stewardship of the earth)*
3-ESS2	Earth's Systems	- Obtain and combine information to describe climates in different regions of the world and focus on the way this diversity impacts a region's culture and lifestyle (*respecting human dignity)*
3-ESS3	Earth and Human Activity	- Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard keeping in mind the way weather hazards impact homeless people (*preferential option for the poor)*

Fourth Grade

4-PS3	Energy	- 4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another with the goal of designing a device that could help low income or homeless people (i.e. a cheap, passive solar heater that converts light into heat) (*the call to family, community, and participation; preferential option for the poor)* - Emphasize proper use of resources and materials through the lens of *stewardship of the Earth*.
4-PS4	Waves and their Applications in Technologies for Information Transfer	- 4-PS4-3: Generate and compare multiple solutions that use patterns to transfer information with the goal of communicating information to individuals in dangerous situations who need help or individuals who have varying disabilities (i.e. deaf, blind) (*the call to family, community, and participation)*
4-LS1	From Molecules to Organisms: Structures and Processes	- 4:LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction and incorporate a discussion on the incredible ways God has intentionally and purposefully created every part of a plant or animal.
4-ESS2	Earth's Systems	- 4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features with the goal of providing this

			information to geologists and park rangers to aid in their work (*stewardship of the earth, dignity and rights of workers)*
4-ESS3	Earth and Human Activity	-	4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans with the goal of creating a brochure to give to people who live in natural disaster prone areas (*stewardship of the earth; the call to family, community, and participation)*

Fifth Grade

5-PS1	Matter and Its Interactions	-	5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen and connect to a discussion on the wonders of God's creation.
5-PS3	Energy	-	5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain warmth) was once energy from the sun with a focus on the importance of respecting all parts of an animal's environment due to their interconnectedness (*stewardship of the earth)*
5-LS1	From Molecules to Organisms: Structures and Processes	-	5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water and connect the argument to our responsibility keep the air and water clean for the other members of our environment (*stewardship of the earth)*
5-LS2	Ecosystems: Interactions, Energy, and Dynamics	-	5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment with a discussion on the responsibility we have to keep our environment clean because of the impact of pollution on the movement of matter through ecosystems (*stewardship of the earth)*
5-ESS1	Earth's Place in the Universe	-	5-ESS1-2: 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 with the goal of presenting the displays to younger students or at a school community night (*the call to family, community, and participation)*
5-ESS2	Earth's Systems	-	5-ESS2-2: 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 and use these graphs to create an argument for water conservation (*stewardship of the earth)*

5-ESS2	Earth and Human Activity	-	5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (*stewardship of the Earth)*.

Section II: Middle School

Note: The following Catholic Social Teaching and Catholic Identity Correlations are project/mini-lesson ideas for each Topical Arrangement.

Physical Science

Topical Arrangement	**CST/Catholic Identity Suggestions**
Structure and Properties of Matter	PS1-3 is to "collect and analyze information to describe that synthetic material come from natural resources and impact society". Create a project around this standard, and other standards within this DMS, in which students explore ways to use their knowledge of structure and properties of matter to ensure that natural resources are used wisely and carefully, showing good *stewardship of the Earth.*
Chemical Reactions	Design and engineer solar ovens as a project for developing countries.
Forces and Interactions	Research and present on how forces and gravity affect the design of churches and tall cathedrals (i.e. buttresses, columns, and arches)
Energy	Research and present on the ethical implications of electronic devices that transmit radiation.
Waves and Electromagnetic Radiation	

Earth and Space Science

Topical Arrangement	**CST/Catholic Identity Suggestions**
Space Systems	Research and connect the liturgical calendar to the natural patterns in the solar system (God's Universe!)
History of Earth	Research the ways that scientific explanations of Earth's development are explained by Catholic scientists.
Earth's Systems	ESS2-4 states "develop a model to describe the cycling of water through Earth's systems driver by energy from the sun and the force of gravity". Create a project in which students develop such a model, incorporating suggestions for way Tucson residents can capitalize on these systems to conserve water and therefore practice *stewardship of the Earth.*
Weather and Climate	Research the evidence and causes of the rise in global temperatures, and propose solutions to global warming issues (*stewardship of the*

	earth)
Human Impact	**See above project suggestions, could focus specifically on reducing human impact on the environment with carbon footprint, etc.**

Life Science

Topical Arrangement	**CST/Catholic Identity Suggestions**
Structure, Function and Information Processing	Research and use evidence to defend life-affirming technology versus controversial technological processes (i.e. stem cells, cloning, etc.)
Matter and Energy in Organisms and Ecosystems	Create a PSA that explains (with evidence) the importance of protecting organisms and their ecosystems. May specifically focus on the introduction of non-native species into an ecosystem or the human impact on the balance of food webs.
Interdependent Relationships in Ecosystems	
Growth, Development, and Reproduction in Organisms	Research and present on the ethical implications of genetic engineering for humans.
Natural Selection and Adaptations	Research St. John Paul II's 1996 message to the Pontifical Academy of Sciences and Pop Pius XII's 1950 encyclical Humani Generis on evolution.

Section III: High School

Note: The following is a list of the Performance Objectives (PO) or Diocesan Performance Objectives (DPO) by strand and concept that have a connection to Catholic Social Teaching and/or Catholic Identity.

Strand 2: History and Nature of Science

Concept 1: History of Science as a Human Endeavor		
PO 1	Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.	HS-ESS3-1
DPO 2	Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations and concepts.	
DPO 4	Analyze how specific cultural, religious, and/or societal issues promote or hinder scientific advancements.	
Diocesan Concept 3: Catholic Ethics in use of scientific information		
DPO 1	Understand that Catholic teachings are rooted in a commitment to promote and defend human dignity; this is the foundation of its concern to respect the sacredness of every human life from the moment of conception until death.	
DPO 2	Discuss issues that contradict Catholic ethical teachings. Scientific pursuits should conform to that morality, for example: • Stem cell research • Appropriate use of laboratory animals in experimentation and research • Use of natural resources • Availability and testing in medical technology • Nuclear energy issues • Space exploration • Research for military applications	

Diocesan Strand 3: Science in Personal, Social, and Spiritual Perspectives

Concept 1: Changes in Environments		
DPO 1	Evaluate how the processes of natural ecosystems affect, and are affected by, humans.	HS-LS2-7 HS-ESS3-1
DPO 2	Describe the effects of natural and/or human-caused hazards, for example: • Flooding • Drought • Earthquakes • Fires • Pollution • Extreme weather	HS-ESS3-1

	• Global climate change	
DPO 3	Assess how human activities, such as those listed, can affect the potential for hazards: • Industrial activity • Agriculture • Forestry • Range (grazing) • Water management • Personal lifestyle choices	HS-PS2-6 HS-PS4-4 HS-ESS3-1
DPO 4	Propose appropriate safety measures that can be taken in preparation for: • Geologic disasters • Human made disasters • Severe weather disasters	
DPO 5	Evaluate factors that affect the quality of the environment, for example: • Recycling • Green choices • Stewardship of resources • Urban development • Natural and man-made pollution sources	HS-LS2-7 HS-ESS3-4
DPO 6	Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality, biodiversity, and sustainability	HS-LS2-7 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4
DPO 7	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.	HS-ESS2-2 HS-ESS3-5
DPO 8	Use computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	HS-ESS3-6
Diocesan Concept 2: Science and Technology in Society		
DPO 1	Analyze the costs, benefits, and risks of various ways of dealing with issues arising from science and technology, for example: • Various forms of alternative energy • Storage of nuclear waste • Abandoned mines • Greenhouse gases • Hazardous wastes • Water management	HS-PS4-4 HS-ESS3-2 HS-ESS3-4
DPO 2	Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology and teachings of the Catholic Church.	
DPO 3	Analyze multiple positions on science or technology issues.	HS-PS4-2 HS-PS4-4

DPO 4	Analyze the use of renewable and nonrenewable resources, for example: • Water • Land • Soil • Minerals • Air	HS-PS4-2 HS-ESS3-1 HS-ESS3-3
DPO 5	Evaluate the effectiveness of methods used to manage natural resources.	HS-ESS3-1 HS-ESS3-3
Diocesan Concept 3: Human Population Characteristics		
DPO 1	Analyze social factors that affect the growth of a human population, for example: • Affluence • Education • Health care • Cultural and spiritual influences • Management of natural resources and biodiversity	HS-ESS3-3
PO 2	Describe biotic (living) and abiotic (nonliving) factors that affect human populations.	HS-ESS3-1
PO 3	Predict the effect of a change in specific factors on a human population: • Birth rate • Death rate • Immigration • Emigration • Carrying capacity of the environment	HS-LS2-1 HS-ESS3-1 HS-LS2-6
Diocesan Concept 4: Ethics in the development and use of scientific information		
DPO 1	Analyze technology that raises social, moral, ethical, and legal issues with respect to the sacredness of human life, for example: • Prevent or facilitate pregnancy • End of life • Quality of life • Disability • Processes such as cloning and embryonic stem cell research	
DPO 2	Analyze technology that raises social, moral, ethical and legal issues with respect to animal life, for example: • Research with animal subjects • Humane treatment of animals	HS-LS2-7
DPO 3	Analyze global issues as they impact humanity, for example: • Climate change • Resource management • Sustainability	HS-ESS3-1 HS-ESS3-5 HS-ESS3-6
Diocesan Concept 5: Engineering Design as an Ethical Response		
DPO 1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and	HS-LS2-7 HS-ETS1-1

	wants.	
DPO 2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	HS-LS2-7 HS-ETS1-2
DPO 3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	HS-LS2-7 HS-ESS3-4 HS-ETS1-3
DPO 4	Use a computer simulation to model the impact of proposed solutions to a complex, real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	HS-LS4-6 HS-ESS3-3 HS-ETS1-4

Strand 4: Life Science

Concept 3: Interdependence of Organisms		
DPO 1	Analyze the relationships among organisms at different levels of organization: • Populations • Communities (group behavior) • Ecosystems • Biomes	MS-LS2-2 HS-LS2-2 HS-LS2-6 HS-LS2-8

Strand 6: Earth and Space Science

Concept 2: Energy in the Earth System		
DPO 15	Investigate the effects of acid rain, smoke (forest fires and industrial exhaust), volcanic dust, urban development, and greenhouse gases, on weather and climate change over varying periods of time.	HS-ESS2-4

THE SCIENCE PROCESS TERMINOLOGY

The processes of science are skills that develop knowledge, concepts, and application across the curriculum. The processes are often referred to as the “hands-on” laboratory approach to science and must be used throughout the program. Each of the terms has been adapted from American Association for the Advancement of Science and Science Curriculum Improvement Studies and implies active student participation.

OBSERVING: Using the senses to gather information about objects and events in the environment. This skill includes using scientific instruments to extend the range of the human senses and the ability to differentiate relevant from non-relevant.

INQUIRING: Emanates from a student generated question. The student desires to understand scientific ideas or to develop knowledge. The student develops authentic, real world investigations which foster a deeper understanding.

CLASSIFYING: A method for establishing order on collections of objects or events. Students use classification systems to identify objects or events, to show similarities, differences, and interrelationships. It is important to realize that all classification systems are subjective and may change as criteria change. The test for a good classification system is whether others can use it.

MEASURING: A procedure for using instruments to determine the length, area, volume, mass, or other physical properties of an unknown quantity. It requires the proper use of instruments and the ability to calculate the measured results.

QUANTIFYING: The skill includes: number sense, computation, estimation, spatial sense, and higher order mathematical operations.

***COMMUNICATING**:* Transmitting the results of observations and experimental procedures to others through the use of such devices as: graphs, charts, tables, written descriptions, technology, oral presentations, expository writing, etc. Communication is fundamental to science, because it is in exchanging ideas and results of experiments that knowledge is validated by others.

QUESTIONING: The formulating of original questions based on observations and experiences with an event in such a way that one can experiment to seek the answers.

RELATING: In the sciences, information about relationships can be descriptive or experimental. Relationships are based on logical arguments that encompass all data. Hypothetical reasoning, deductive reasoning, coordinate graphing, the managing of variables, and the comparison of effects of one variable upon another contribute to understanding the major concepts of science.

INFERRING: An inference is a tentative explanation that is based on partial observations. Available data is gathered and an evaluation made based on the observed data. These judgments are never absolute and reflect what appears to be the most probable explanation at the time and are subject to change as new data is accumulated.

PREDICTING: Using previously-observed information to determine probable outcomes about future events.

FORMULATING HYPOTHESES: Stating a probable outcome for an occurrence based on observations and inferences. The validity of the hypothesis is determined from testing and data analysis.

IDENTIFYING AND CONTROLLING VARIABLES: Determining what elements in a given investigation will vary or change and what will remain constant. Ideally scientists will attempt to identify all the variables before an investigation is conducted. By manipulating one variable at a time they can determine how that variable will affect the outcome.

EXPERIMENTING*:* Experimentation often begins with observations, which lead to questions that need answers. The steps for proceeding may include forming a hypothesis, identifying and controlling variables, designing the procedure for conducting tests, implementing tests, collecting and interpreting the data and reaching a conclusion.

APPLYING*:* The process of inventing, creating, problem solving, and determining probabilities are applications of using knowledge to discover further information.

CONSTRUCTING MODELS: Developing physical or mental representations to explain an idea, object or event. Models are usually developed on the basis of an acceptable hypothesis.

SCIENCE STANDARDS
Grades K-8

CODE:	
Elementary Science Standards 1.S5.C2.DPO1 (2008) = Grade 1, Strand 5, Concept 2, Diocesan Performance Objective 1. Explanations and Related materials are color coded:	
Green	Catholic Identity
Orange	Science and Engineering Practices
Blue	Disciplinary ideas
Highlighted sections show Diocesan standards committee additions.	

*The highlighted sections were added by the committee due to a recognition that content that they viewed as crucial had been omitted by the NGSS. Additionally, there are a number of NGSS that were omitted by the diocesan curriculum committee because they were viewed as developmentally inappropriate or contrary to the teachings of the Catholic faith.

Note to the teachers:
In developing the 2015 science standards for the Catholic Schools of the Diocese, the science teachers of the committee recognized the recurring theme of student-led discovery learning. While there is merit and research to support the importance of student engagement through developing models and trial and error through testing hypotheses, we want to make it clear that it is with the support of the teachers' expertise and guidance that students must still experience a good amount of instruction, assessment, and evaluation of the quality of solutions attempted through discovery. We also believe it is essential that the teacher is the moral guide in the classroom to guide students' understanding of the moral and ethical aspects of science. These elements of the Diocesan standards are the core of our mission and may not be found in your textbooks or in your teaching materials. Therefore, it is with great faith that we place the intent of the Diocesan standards in the hands of our teachers to teach process, content, and effective problem solving through high expectations and with the Catholic worldview at the center of it all.

K. Forces and Interactions: Pushes and Pulls

Students who demonstrate understanding can:

K.PS2.1. **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]

K.PS2.DPO.1. **Demonstrate the various ways that objects can move (e.g. straight line, zigzag, back-and-forth, round-and-round, fast, slow.**
Formerly 1.S5.C2.DPO1.

K.PS2.2. **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Grade K Science Standards and DPOs

K. Forces and Interactions: Pushes and Pulls

Students who demonstrate understanding can:

K.PS2.1. Tier 1	**Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]
K.PS2.DPO.1. Tier 1	**Demonstrate the various ways that objects can move (e.g. straight line, zigzag, back-and-forth, round-and-round, fast, slow.** ***Formerly 1.S5.C2.DPO1.***
K.PS2.2. Tier 2	**Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Show respectful interaction. • Use simple tools to make tasks easier. Use God given intellect to approach the tasks.	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • With guidance, plan and conduct an investigation in collaboration with peers. (K.PS2.1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (K.PS2.2) - ***Connections to the Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientists use different ways to study the world. (K.PS2.1)	**PS2.A: Forces and Motion** • Pushes and pulls can have different strengths and directions. (K.PS2.1), (K.PS2.2) • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K.PS2.1),(K.PS2.2) **PS2.B: Types of Interactions** • When objects touch or collide, they push on one another and can change motion. (K.PS2.1) **PS3.C: Relationship Between Energy and Forces** • A bigger push or pull makes things speed up or slow down more quickly. *(secondary to K.PS2.1)* **ETS1.A: Defining Engineering Problems** A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. *(secondary to K.PS2.2)*

K. Interdependent Relationships in Ecosystems: Animals, Plants, and their Environment

Students who demonstrate understanding can:

K.LS1.1. **Tier 1**	**Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]
K.LS1. DPO1. **Tier 1**	**Identify plants and animals that exist in the local environment.** ***Formerly 1.S4.C3.DPO1***
K.LS1.DPO2. **Tier 1**	**Compare habitats (e.g. desert, forest, prairie, water underground) in which plants and animals live.** ***Formerly 1.S4.C3.DPO2.***
K.ESS2.2. **Tier 2**	**Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]
K.ESS2.DPO1. **Tier 1**	**Describe how plants and animals within a habitat are dependent on each other.** ***Formerly 1.S4.C3. DPO3.***
K.ESS3.1. **Tier 2**	**Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.** [Examples of relationships could

	include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]
K.ESS3.DPO1. Tier 1	**Know that animals require air, water, food, and shelter; plants require air, water, nutrients, and light.** ***Formerly 1.S4.C3.DPO4.***
K.ESS3.3. Tier 2	**Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]
K.ESS3.DPO2. Tier 1	**Identify ways to conserve natural resources (e.g. reduce, reuse, recycle, find alternatives.** ***Formerly 1.S6.C1.DPO5.***

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Understand that all plants and animals are part of God's creation. • Identify practices of good stewardship and responsible conservation of resources (i.e., reduce, reuse, and recycle). • Discuss reverence for all God's creations. • Identify how humans differ from other living things because of their heart, mind, and soul.	**Developing and Using Models** Analyzing Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. • Use a model to represent relationships in the natural world. (K.ESS3.1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K.LS1.1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** • All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K.LS1.1) **ESS2.E: Bio geology** • Plants and animals can change their environment. (K.ESS2.2) **ESS3.A: Natural Resources** • Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K.ESS3.1)
	Connections to the Nature of Science **Engaging in Argument from Evidence** Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Construct an argument with evidence to support a claim. (K.ESS2.2) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K.ESS3.3) - *Connections to Nature of Science*	**ESS3.C: Human Impacts on Earth Systems** • Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K.ESS3.3) **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary to K.ESS3.3)*

	Scientific Knowledge is Based on Empirical Evidence Scientists look for patterns and order when making observations about the world. (K.LS1.1)	

K. Weather and Climate

Students who demonstrate understanding can:

K.PS3.1. **Tier 1**	**Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]
K.PS3.DPO1. **Tier 1**	**Identify evidence that the Sun is the natural source of heat and light on the Earth (e.g., warm surfaces, shadows, shade).** ***Formerly 1.S6.C2.DPO1.***
K.PS3.2. **Tier 1**	**Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]
K.ESS2.1. **Tier 2**	**Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]
K.ESS2.DPO1. **Tier 1**	**Identify the following characteristics of seasonal weather patterns: temperature, type of precipitation, and wind.** ***Formerly 1.S6.C3.DPO1.***
K.ESS2.DPO2. Tier 1	**Analyze how the weather affects daily activities.** ***Formerly 1.S6.C3.DPO2.***
K.ESS3.2. **Tier 2**	**Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]
K.ESS3.DPO1. **Tier 1**	**Know that short-term weather conditions (e.g. temperature, rain, snow) can change daily and weather patterns can change over the seasons.** ***Formerly 1.S6.C3.DPO3.***

The performance expectations developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas

:
• Share materials and work together in small groups, listen to the ideas of others. Show respect to others. Treat others as you want to be treated.
• Share Biblical stories related to weather and climate: Creation story or Noah. Consider what it would be like to spend 40 days in the desert.
• How do other life forms utilize the sun for sustenance?
• Relate various seasons to different cycles of the Church.
  ○ Why did God create the sun?
  ○ What do we use the sun for?
  ○ What other life forms, (i.e. plants and insects)
	Asking Questions and Defining Problems
	Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
	• Ask questions based on observations to find more information about the designed world. (K. ESS3.2)
	Planning and Carrying Out Investigations
	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
	• Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K.PS3.1)
		PS3.B: Conservation of Energy and Energy Transfer
		• Sunlight warms Earth's surface. (K.PS3.1),(K.PS3.2)
		ESS2.D: Weather and Climate
		• Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K.ESS2.1)
		ESS3.B: Natural Hazards
		• Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K.ESS3.2)

need the sun?		

(Continued)

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
	Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K.ESS2.1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K.PS3.2) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K.ESS3.2) - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientists use different ways to study the world. (K.PS3.1) **Science Knowledge is Based on Empirical Evidence** Scientists look for patterns and order when making observations about the world. (K.ESS2.1)	**ETS1.A: Defining and Delimiting an Engineering Problem** • Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary to K.ESS3.2)*

K-2 Engineering Design

Students who demonstrate understanding can:

K-2.ETS1.1.	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
K-2.ETS1.2.	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
K-2.ETS1.3.	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Use simple tools to make tasks easier. Use God given intellect to approach the tasks. • Consider Biblical stories that highlight building, moving structures, etc., such as the building of the pyramids. (Consider: Can a mountain be moved? A building? A brick? Demonstrate.) • Compare engineering design and God's intellectual design of life forms. • Compare designs of cathedral structures and their components. Use blocks to show complexity of design elements.	**Asking Questions and Defining Problems** Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. • Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2.ETS1.1) • Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2.ETS1.1) **Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool. (K-2.ETS1.2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (K-2.ETS1.3)	**ETS1.A: Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2.ETS1.1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2.ETS1.1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2.ETS1.1) **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2.ETS1.2) **ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2.ETS1.3)

Grade 1 Science Standards and DPOs

1. Waves: Light and Sound

Students who demonstrate understanding can:

1.PS4.1. **Tier 1**	**Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]
1.PS4.1.DPO1. **Tier 1**	**Demonstrate that vibrating objects produce sound.** ***Formerly 3.S5.C3.DPO3.***
1.PS4.2. **Tier 1**	**Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]
1.PS4.2.DPO1. **Tier 1**	**Describe how light behaves on striking objects that are: Transparent (clear plastic), Translucent (waxed paper), Opaque (cardboard).** ***Formerly 3.S5.C3.DPO2.***
1.PS4.3. **Tier 1**	**Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [*Assessment Boundary: Assessment does not include the speed of light.*]
1.PS4.4. **Tier 2**	**Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Describe how suitable tools help make better observations and measurements. • 4.2DPO1—Reference the rainbow, God's covenant. • 4.2DPO1—Reference and show stained glass windows and the process of light passing through transparent and translucent glass.	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct investigations collaboratively to produce evidence to answer a question. (1.PS4.1),(1.PS4.3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.	**PS4.A: Wave Properties** • Sound can make matter vibrate, and vibrating matter can make sound. (1.PS4.1) **PS4.B: Electromagnetic Radiation** • Objects can be seen if light is available to illuminate them or if they give off their own light. (1.PS4.2) • Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1.PS4.3)

(Continued)

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
	• Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1.PS4.2) • Use tools and materials provided to design a device that solves a specific problem. (1.PS4.4) - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Science investigations begin with a question. (1.PS4.1) • Scientists use different ways to study the world. (1.PS4.1)	**PS4.C: Information Technologies and Instrumentation** People also use a variety of devices to communicate (send and receive information) over long distances. (1.PS4.4)

1.Structure, Function, and Information Processing

Students who demonstrate understanding can:

1.LS1.1. **Tier 1**	**Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*** [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]
1-LS1-1-DPO1. **Tier 1**	**Identify the following as characteristics of living things: Growth and Development, Reproduction, Response to Stimulus.** ***Formerly 1.S4.C1.DPO1.***
1.-LS1-1-DPO2. **Tier 1**	**Compare the following observable features of living things: Movement (legs, wings), Protection (skin, feathers, tree bark), Respiration (lungs, gills), Support (plant stems, tree trunks).** ***Formerly 1.S4.C1.DPO2.***
1.LS1.1.DPO3. **Tier 1**	**Identify observable similarities and differences (e.g., number of legs, body, coverings, size) between/among different groups of animals.** ***Formerly 1.S4.C1.DPO3.***
1.LS1.1.DPO4. **Tier 1**	**Understand the function and importance of the five senses.** ***Formerly 1.S4.C1.DPO4.***
1.LS1.2. **Tier 2**	**Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.**[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]
1.LS1.2.DPO1. **Tier 2**	**Identify stages of human life (e.g., infancy, adolescence, adult).** ***Formerly 1.S4.C2.DPO1.***
1.LS3.1. **Tier 2**	**Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.** [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [*Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.*]
1.LS3.1.DPO1. **Tier 1**	**Identify similarities and differences between animals and their parents.** ***Formerly 1.S4.C2.DPO2.***

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Use simple tools to make tasks easier. Use God given intellect to approach the tasks. • Understand that God created man in his own image. • Reference Genesis. Identify aspects of the creation story and how all living things came to be. • Use the five senses to appreciate skin, fur, feathers, etc. in understanding the creation story. • Consider "creating" animals from materials and the care that goes into forming a creation. Consider how a creator cares for a creation and keeps it safe?	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1.LS3.1) • Use materials to design a device that solves a specific problem or a solution to a specific problem. (1.LS1. 1) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.	**LS1.A: Structure and Function** • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1.LS1.1) **LS1.B: Growth and Development of Organisms** • Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1.LS1.2)

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
	• Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1.LS1.2) - *Connections to Nature of Science* **Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world. (1.LS1.2)	**LS1.D: Information Processing** • Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1.LS1.1) **LS3.A: Inheritance of Traits** • Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents. (1.LS3.1) **LS3.B: Variation of Traits** • Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1.LS3.1)

1. Space Systems: Patterns and Cycles

Students who demonstrate understanding can:

1.ESS1.1. **Tier 1**	**Use observations of the sun, moon, and stars to describe patterns that can be predicted.** [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]
1.ESS1.1.DPO1. **Tier 1**	**Compare celestial objects (e.g., Sun, Moon, stars) and transient objects in the sky (e.g., clouds, birds, airplanes, contrails).** ***Formerly 1.S6.C2.DPO2.***
1.ESS1.1.DPO2. **Tier 1**	**Describe observable changes that occur in the sky. (e.g., clouds forming and moving, the position of the Moon.** ***Formerly 1.S6.C2.DPO3.***
1.ESS1.1.DPO3. **Tier 1**	**Identify how diverse people and/or cultures, past and present, have made important contributions to scientific innovations (e.g., Sally Ride [scientist], Neil Armstrong [astronaut, engineer].** ***Formerly 1.S2.C1.DPO2.***
1.ESS1.2. **Tier 2**	**Make observations at different times of year to relate the amount of daylight to the time of year.** [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Reference creation of the sun and moon Genesis. • Reference the star of Bethlehem as the heavenly body that brought the wise men to Jesus and the stars as the guide for Columbus crossing the ocean. • Identify how diverse people and/or cultures, past and present, have made important contributions to scientific innovations using God's gifts (e.g., Sally Ride [scientist], Neil Armstrong [astronaut, engineer]. They were inspired by their intellect and drawn to the heavens out of curiosity. • Introduce the term "Heavenly Bodies" and explain the phrase in relation to their place in the universe.	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. (1.ESS1.2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (1.ESS1.1)	**ESS1.A: The Universe and its Stars** • Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1.ESS1.1) **ESS1.B: Earth and the Solar System** • Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1.ESS1.2)

K-2 Engineering Design

Students who demonstrate understanding can:

K-2.ETS1.1.	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
K-2.ETS1.2.	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
K-2.ETS1.3.	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Use simple tools to make tasks easier. Use God given intellect to approach the tasks. • Consider Biblical stories that highlight building, moving structures, etc., such as the building of the pyramids. (Consider: Can a mountain be moved? A building? A brick? Demonstrate.) • Compare engineering design and God's intellectual design of life forms. • Compare designs of cathedral structures and their components. Use blocks to show complexity of design elements.	**Asking Questions and Defining Problems** Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. • Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2.ETS1.1) • Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2.ETS1.1) **Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool. (K-2.ETS1.2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (K-2.ETS1.3)	**ETS1.A: Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2.ETS1.1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2.ETS1.1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2.ETS1.1) **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2.ETS1.2) **ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2.ETS1.3)

Grade 2 Science Standards and DPOs

2. Structure and Properties of Matter

Students who demonstrate understanding can:

2.PS1.1. Tier 1	**Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
2.PS1.1.DPO1. Tier 1	**Know that different objects are made up of many different types of materials (e.g., cloth, paper, wood, metal) and have many different observable properties (e.g., color, size, shape, weight).** ***Formerly 1.S5.C1.DPO3.***
2.PS1.1.DPO2. Tier 1	**Describe objects in terms of measurable properties (e.g., length, volume, weight, temperature) using scientific tools.** ***Formerly 2.S5.C1.DPO1.***
2.PS1.2. Tier 1	**Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*]
2.PS1.2.DPO1. Tier 1	**Compare the following physical properties of basic Earth materials: color, texture, capacity to retain water.** ***Formerly 1.S6.C1.DPO2.***
2.PS1.3. Tier 1	**Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]
2.PD1.3.DPO1. Tier 1	**Identify common uses (e.g., construction, decoration) of basic Earth materials (e.g., rocks, water, soil).** ***Formerly 1.S6.C1.DPO3.***
2.PS1.4. Tier 2	**Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]
2.PS1.4.DPO2. Tier 1	**Classify materials solids, liquids, or gases.** ***Formerly 2.S5.C1.DPO2.***
2.PS1.4.DPO3. Tier 1	**Know that water can be a liquid or a solid and can be made to change from one form to the other, but the amount of water stays the same.** ***Formerly 2.S5.C1.DPO3.***
2.PS1.4.DPO4. Tier 1	**Demonstrate that water can exist as a: gas-vapor, liquid-water, solid-ice.** **Formerly 2.S5.C1.DPO4.**
2.PS1.4.DPO5. Tier 1	**Demonstrate that solids have a definite shape and that liquids and gases take the shape of their containers.** ***Formerly 2.S5.C1.DPO5.***

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Listen respectfully to others when they present their findings. Ask appropriate questions. Be respectful. Treat others as you would like to be treated. • Reference the omnipotence and power of God in the multiplying loaves and fishes, the parting of the Red Sea, and water to wine at the wedding at Cana stories (and others). Compare the reality of physical properties, such as melting, freezing, and evaporating, and compare how God's intervention, Miracles, can defy natural order.	**Planning and Carrying Out Investigations** • Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	**PS1.A: Structure and Properties of Matter** • Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2.PS1.1)

(Continued)

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• In preparation for Eucharist, reference the concept of Transubstantiation as a miracle that happens at mass. Man cannot change a physical property without changing its components, but God can and does when the body and blood change into Jesus.	• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2.PS1.1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (2.PS1.2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2.PS1.3) **Engaging in Argument from Evidence** Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Construct an argument with evidence to support a claim. (2.PS1.4) - ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science searches for cause and effect relationships to explain natural events. (2.PS1.4)	**PS1.A: Structure and Properties of Matter** • Different properties are suited to different purposes. (2.PS1.2),(2.PS1.3) • A great variety of objects can be built up from a small set of pieces. (2.PS1.3) **PS1.B: Chemical Reactions** • Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2.PS1.4)

2. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

2.LS2.1. **Tier 1**	**Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [*Assessment Boundary: Assessment is limited to testing one variable at a time.*]
2.LS2.2. **Tier 2**	**Develop a simple model that mimics the function of an animal in dispersing seeds or Pollinating plants.***
2.LS4.1. **Tier 1**	**Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [*Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.*]
2.LS4.1.DPO1. **Tier 1**	**Identify some plant and animals that exist in the local environment.** ***Formerly 1.S4.C3.DPO1.***
2.LS4.1.DPO2. **Tier 1**	**Compare the habitats (e.g., desert, forest, prairie, water, underground) in which plants and animals live.** ***Formerly 1.S4.C3.DPO2.***
2.LS4.1.DPO3. **Tier 1**	**Describe how plants and animals within a habitat are dependent on each other.** ***Formerly 1.S4.C3.DPO3.***
2.LS4.1.DPO4. **Tier 1**	**Compare life cycles of various plants (e.g., conifers, flowering plants, ferns).** ***Formerly 3.S4.C2.DPO1***
2.LS4.1.DPO5. **Tier 1**	**Explain how growth, death, and decay are part of the plant life cycle.** ***Formerly 3.S4.C2.DPO2.***

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Listen respectfully to others when they present their findings. Ask appropriate questions. Be respectful. Treat others as you would like to be treated. • Understand that plants are a part of God's creation and require us to care for them. • Reference Genesis: In the Garden of Eden, everything was given to Adam and Eve. Once they were banished, they had to work the land. Make a connection to gardening, the cycle of life and death related to growth and decay. • Compare the death and resurrection to the life cycle of a perennial flower (i.e. tulip) or tree that dies and revives as the seasons.	**Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool. (2.LS2.2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2.LS2.1) • Make observations (firsthand or from media) to collect data which can be used to make comparisons. (2.LS4.1) - *Connections to Nature of Science* **Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world. (2.LS4.1)	**LS2.A: Interdependent Relationships in Ecosystems** • Plants depend on water and light to grow. (2.LS2.1) • Plants depend on animals for Pollination or to move their seeds around. (2.LS2.2) **LS4.D: Biodiversity and Humans** • There are many different kinds of living things in any area, and they exist in different places on land and in water. (2.LS4.1) **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary to 2.LS2.2)*

2.Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2.ESS1.1.	**Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [*Assessment Boundary: Assessment does not include quantitative measurements of timescales.*]
2.ESS1.1.DPO1. **Tier 1**	**Classify objects by the following observable properties: shape, texture, size, color, weight.** ***Formerly 1.S5.C1.DPO1.***
2.ESS1.1.DPO2. **Tier 1**	**Describe the following basic Earth materials: rocks, soil, water.** ***Formerly 1.S6.C1.DPO1.***
2.ESS2.1. **Tier 2**	**Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.***[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]
2.ESS2.2. **Tier 2**	**Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [*Assessment Boundary: Assessment does not include quantitative scaling in models.*]
2.ESS2.3. **Tier 1**	**Obtain information to identify where water is found on Earth and that it can be solid or liquid.**
2.ESS2.3.DPO1. **Tier 1**	**Classify materials as solids and liquids.** **Formerly 1.S5.C1.DPO2.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Listen respectfully to others when they present their findings. Ask appropriate questions. Be respectful. Treat others as you would like to be treated. • Relate God's creation and design to current earth systems and structures.	**Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a model to represent patterns in the natural world. (2.ESS2.2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations from several sources to construct an evidence-based account for natural phenomena. (2.ESS1.1) • Compare multiple solutions to a problem. (2.ESS2.1) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2.ESS2.3)	**ESS1.C: The History of Planet Earth** • Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2.ESS1. 1) **ESS2.A: Earth Materials and Systems** • Wind and water can change the shape of the land. (2.ESS2.1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2.ESS2.2) **ESS2.C: The Roles of Water in Earth's Surface Processes** • Water is found in the ocean, rivers, lakes, and Ponds. Water exists as solid ice and in liquid form. (2.ESS2.3) **ETS1.C: Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs. *(secondary to 2.ESS2.1)*

K-2 Engineering Design

Students who demonstrate understanding can:

K-2.ETS1.1.	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
K-2.ETS1.2.	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
K-2.ETS1.3.	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Catholic Identity	Science and Engineering Practices	Disciplinary Ideas
• Share materials and work together in small groups, listen to the ideas of others. Be respectful. Treat others as you would like to be treated. • Use simple tools to make tasks easier. Use God given intellect to approach the tasks. • Consider Biblical stories that highlight building, moving structures, etc., such as the building of the pyramids. (Consider: Can a mountain be moved? A building? A brick? Demonstrate.) • Compare engineering design and God's intellectual design of life forms. • Compare designs of cathedral structures and their components. Use blocks to show complexity of design elements.	**Asking Questions and Defining Problems** Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. • Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2.ETS1.1) • Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2.ETS1.1) **Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool. (K-2.ETS1.2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (K-2.ETS1.3)	**ETS1.A: Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2.ETS1.1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2.ETS1.1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2.ETS1.1) **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2.ETS1.2) **ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2.ETS1.3)

Third Grade

Essential questions answered in Third Grade Science Standards:

- How can the impact of weather-related hazards be reduced?
- How do organisms vary in their traits?
- How are plants, animals, and environments of the past similar or different from current plants, animals, and environments?
- What happens to organisms when their environment changes?
- How do equal and unequal forces on an object affect the object?
- How can magnets be used in third grade?
- What is God's design for the environment?
- In what ways does our Catholic faith influence our view of the natural world?

Grade 3 Science Standards and DPOs

3. Forces and Interactions

Students who demonstrate understanding can:	
3.PS2.1. **Tier 1**	**Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]
3.S5.C2.DPO1. **Tier 2**	**Define and describe the forces of gravity and friction. *(Formerly 5.S5.C2.DPO1)***
3.PS2.2. **Tier 1**	**Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]
3.PS2.3. **Tier 2**	**Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]
3.S5.C3.DPO4. **Tier 1**	**Investigate the characteristics of magnets (e.g., opposite poles attract, like poled repel, the force between two magnets poles depends on the distance between them). *(Formerly 4.S5.C.3.DPO4)***
3.S5.C3.DPO 5. **Tier 2**	**State cause and effect relationships between magnets and circuitry. (Formerly 4.S5.C3.DPO5)**
3.PS2.4. **Tier 2**	**Identify and explain a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Place physical obstacles between a magnet and a metal object. Explain that the greater the object (or obstacle/sin) the more difficult it is for us to feel the draw of God. Talk about obstacles or sins that can keep us from feeling God's invitation for love.

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<tr><th>Science and Engineering Practices</th><th>Disciplinary Ideas</th><th>Crosscutting Concepts</th></tr>
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Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

Ask questions that can be investigated based on patterns such as cause and effect relationships. (3.PS2.3)
Define a simple problem that can be solved through the development of a new or improved object or tool. (3.PS2.4)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3.PS2.1)
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3.PS2.2)

Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence

Science findings are based on recognizing patterns. (3.PS2.2)
Scientific Investigations Use a Variety of Methods

Science investigations use a variety of methods, tools, and techniques. (3.PS2.1)
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<td>
PS2.A: Forces and Motion

Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3.PS2.1)
The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3.PS2.2)

PS2.B: Types of Interactions

Objects in contact exert forces on each other. (3.PS2.1)
Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3.PS2.3),(3.PS2.4)

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Patterns

Patterns of change can be used to make predictions. (3.PS2.2)

Cause and Effect

Cause and effect relationships are routinely identified. (3.PS2.1)
Cause and effect relationships are routinely identified, tested, and used to explain change. (3.PS2.3)

----------------------Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology

Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3.PS2.4)
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3. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:	
3.LS2.1. Tier 2	**Construct an argument that some animals form groups that help members survive.**
3.LS4.1. Tier 1	**Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]
3.S6.C1.DPO4. Tier 1	**Describe fossils as a record of past forms.**
3.S6.C1.DPO5. Tier 1	**Describe how fossils are formed.**
3.LS4.3. Tier 1	**Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
3.S4.C3.DPO1. Tier 1	**Identify the living and nonliving components of an ecosystem.**
3.S4.C3.DPO2. Tier 1	**Describe the components of an ecosystem.**
3.S4.C3.DPO3. Tier 1	**Examine an ecosystem to identify microscopic and macroscopic organisms.**
3.S4.C3.DPO1.1. Tier 2	**Describe ways various resources (e.g., air, water, plants , animals, soil) are utilized to meet the needs of population. *(Formerly 4.S4.C3.DPO 1)***
3.S4.C3.DPO3.1. Tier 2	**Analyze the effect that limited resources (e.g., natural gas, minerals) may have on an environment. *(Formerly 4.S4.C3.DPO3)***
3.LS4.4. Tier 1	**Defend the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]
3.S4.C3.DPO6. Tier 2	**Describe how plants and animals cause changes in their environment.**
3.S4.C3.DPO7. Tier 1	**Describe how environmental factors (e.g., soil composition, range of temperature, quantity and quality of light) in the ecosystem may affect a member organism's ability to grow, reproduce, and thrive.**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Understand that all plants and animals are God's creation and require us to care for it.
- Recognize we are stewards of all God's creation and that we were made in His image and likeness.
- Identify causes and effect of hunger in the world.
- Describe the development of different technologies (medicine, communication, entertainment, transportation) in response to resources, needs and values.
- Find out how students in your school can help families affected by a natural disaster. Plan a way to help in a small way. Propose a solution, resource, or product that addresses a specific human, animal, or habitat need.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning. (3.LS4.1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds. • Construct an argument with evidence, data, and/or a model. (3.LS2.1) • Construct an argument with evidence. (3.LS4.3) • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3.LS4.4) **LS2.D: Social Interactions and Group Behavior** • Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. *(Note: Moved from K–2) (3.LS2.1)* **LS4.A: Evidence of Common Ancestry and Diversity** • Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: Moved from K–2) (3.LS4.1)* • Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3.LS4.1) **LS4.C: Adaptation** • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3) **LS4.D: Biodiversity and Humans** • Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3.LS4.4)	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (3.LS2.1),(3.LS4.3) • Scale, Proportion, and Quantity Observable phenomena exist from very short to very long time periods. (3.LS4.1) **Systems and System Models** • A system can be described in terms of its components and their interactions. (3.LS4.4) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Knowledge of relevant scientific concepts and research findings is important in engineering. (3.LS4.4) ------------***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural System** Science assumes consistent patterns in natural systems. (3.LS4.1)

3. Inheritance and Variation of Traits: Life Cycles and Traits

3.LS1.1. **Tier 1**	**Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]
3.S4.C2.DPO1. **Tier 1**	**Compare life cycles of various plants (e.g., conifers, flowering plants, ferns)**
3.S4.C2.DPO2. **Tier 1**	**Explain how growth and decay are part of the plant life cycle.**
3.LS3.1. **Tier 2**	**Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]
3.S4.C2.DPO1. **Tier 2**	**Define the terms heredity and genes. *(Formerly 5.S4.C2.DPO1.)***
3.S4.C2.DPO2. **Tier 2**	**Distinguish between physical characteristics which are and are not inherited. (Formerly 5.S4.C2.DPO2)**
3.LS3.2. **Tier 1**	**Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]
3.LS4.2. **Tier 2**	**Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing**. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Recognize that we all have special gifts and talents from God.
- Emphasize the unique trait of having a soul that is specific to humans.
- Recognize respect for all living things as God's creations.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop models to describe phenomena (3.LS1.1) **Analyzing and Interpreting Data** Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning. (3.LS3.1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., observations, patterns) to support an explanation. (3.LS3.2) • Use evidence (e.g., observations, patterns) to construct an explanation. (3.LS4.2) --- Connections to Nature of Science Science Knowledge is Based on Empirical Evidence	**LS1.B: Growth and Development of Organisms** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3.LS1.1) **LS3.A: Inheritance of Traits** • Many characteristics of organisms are inherited from their parents. (3.LS3.1) • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3.LS3.2) **LS3.B: Variation of Traits** • Different organisms vary in how they look and function because they have different inherited information. (3.LS3.1) • The environment also affects the traits that an organism develops. (3.LS3.2) **LS4.B: Natural Selection** • Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3.LS4.2)	**Patterns** • Similarities and differences in patterns can be used to sort and classify natural phenomena. (3.LS3.1) • Patterns of change can be used to make predictions. (3.LS1.1) **Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (3.LS3.2),(3.LS4.2) -------------------------- *Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World* • Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3.ESS3.1) -------------*Connections to Nature of Science* **Science is a Human Endeavor** Science affects everyday life. (3.ESS3.1)

3. Weather and Climate

Students who demonstrate understanding can:

3.ESS2.1. Tier 1	**Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]
3.S6.C3.DPO5. Tier 1	**Interpret the symbols on a weather map or chart to identify the following: temperatures, fronts, precipitation**. (*Formerly* ***4.S6.C3.DPO5.)***
3.ESS2.2. Tier 1	**Obtain and combine information to describe climates in different regions of the world.**
3.S6.C3.DPO6. Tier 2	**Compare weather conditions and various conditions (e.g., regions of Arizona, various U.S. cities, coastal vs. interior geographical regions).** ***(Formerly 4.S6.C3.DPO6.)***
3.ESS3.1. Tier 2	**Defend the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]
Catholic Identity	

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Evaluate the consequences of environmental occurrences that happen either rapidly or over a long period of time and how we are called in solidarity to help those involved in these events.
- Reference the Corporal and Spiritual Works of Mercy to enhance discussion about the impact of severe weather conditions on living things throughout the world.

<table>
<tr><th>Science and Engineering Practices</th><th>Disciplinary Ideas</th><th>Crosscutting Concepts</th></tr>
<tr>
<td>Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
• Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3.ESS2.1)
Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3.ESS3.1)
Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.
• Obtain and combine information from books and other reliable media to explain phenomena. (3.ESS2.2)</td>
<td>ESS2.D: Weather and Climate
• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3.ESS2.1)
• Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3.ESS2.2)
ESS3.B: Natural Hazards
• A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3.ESS3.1)

(Note: This Disciplinary Core Idea is also addressed by 4.ESS3.2.)</td>
<td>Patterns
• Patterns of change can be used to make predictions. (3.ESS2.1),(3.ESS2.2)
Cause and Effect
• Cause and effect relationships are routinely identified, tested, and used to explain change. (3.ESS3.1)

--------------------------- Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World
• Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3.ESS3.1)

--------------Connections to Nature of Science
Science is a Human Endeavor
• Science affects everyday life. (3.ESS3.1</td>
</tr>
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3. Engineering Design

Students who demonstrate understanding can:

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.

Catholic Identity

- Share materials and work together in small groups, listen to the ideas of others. Be respectful and treat others as you wish to be treated.
- Use the God given gift of intellect to be resourceful and use simple tools to make tasks easier.
- Consider the pastoral as well as the practical nature of the problems and solutions we address.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5.ETS1.1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5.ETS1.3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5.ETS1.2)	**ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5.ETS1.1) **ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5.ETS1.2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5.ETS1.3) **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5.ETS1.3)	**Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5.ETS1.1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5.ETS1.2)

Fourth Grade

Essential questions for Fourth Grade Science Standards:

- How can the impact of weather-related hazards be reduced?
- 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?
- What can people do to preserve God's natural creations?
- How can people be protectors and good stewards of God's resources?

Grade 4 Science Standards and DPOs

4. Energy

Students who demonstrate understanding can:	
4.PS3.1. **Tier 1**	**Use evidence to construct an explanation relating the speed of an object to 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.]
4.PS3.2. **Tier 1**	**Make conclusions based on 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.]
4.S5.C3.DPO2. **Tier 2**	**Describe how energy is transferred by using Scientific Method. *(Formerly 5.S5.C3.DPO2.)***
4.PS3.3. **Tier 1**	**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.]
4.PS3.4. **Tier 2**	**Apply scientific ideas to design, test, and refine a device that converts energy from one 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 that converts light into heat. 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.]
4.S5.C3.DPO1. **Tier 2**	**Demonstrate that electricity flowing in circuits can produce light, heat, sound, and magnetic effects.**
4.ESS3.1. **Tier 1**	**Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect 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.]
4.S4.C3.DPO2. **Tier 1**	**Differentiate renewable resources from nonrenewable resources.**
4.S4.C3.DPO3. **Tier 2**	**Analyze the effect that limited resources (e.g., natural gas, minerals) may have on an environment.**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Plan and implement responsible stewardship of God's natural resources.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4.PS3.3) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4.PS3.2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4.PS3.1) • Apply scientific ideas to solve design problems. (4. PS3.4) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. • Obtain and combine information from books and other reliable media to explain phenomena. (4.ESS3.1)	**PS3.A: Definitions of Energy** The faster a given object is moving, the more energy it possesses. (4.PS3.1) energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4.PS3.2),(4.PS3.3) **PS3.B: Conservation of Energy and Energy Transfer** • Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4.PS3.2),(4.PS3.3) • Light also transfers energy from place to place. (4.PS3.2) • Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4.PS3.2),(4.PS3.4) **PS3.C: Relationship Between Energy and Forces** • When objects collide, the contact forces transfer energy so as to change the objects' motions. (4.PS3.3) **PS3.D: Energy in Chemical Processes and Everyday Life** • The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4.PS3.4) **ESS3.A: Natural Resources** • Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4.ESS3.1) **ETS1.A: Defining Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). • Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary to 4.PS3.4)	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (4.ESS3.1) **Energy and Matter** • Energy can be transferred in various ways and between objects. (4.PS3.1), (4. PS3.2), (4.PS3.3), (4. PS3---.4) ***----------------Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology*** • Knowledge of relevant scientific concepts and research findings is important in engineering. (4.ESS3.1) Influence of Engineering, Technology, and Science on Society and the Natural World • Over time, people's needs and wants change, as do their demands for new and improved technologies. (4.ESS3.1) • Engineers improve existing technologies or develop new ones. (4.PS3.4) ***-------------------------------------Connections to Nature of Science*** **Science is a Human Endeavor** • Most scientists and engineers work in teams. (4.PS3.4) Science affects everyday life. (4.PS3.4)

4. Waves: Waves and Information

Students who demonstrate understanding can:	
4.PS4.1. Tier 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.]
4.PS4.1.1. Tier 2	**Discuss how changes in amplitude and wavelength can affect how an object moves.**
4.PS4.3. Tier 2	**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.]

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) -- *ConnectionstoNatureofScience* **Scientific Knowledge is Based on Empirical Evidence** ▪ Science findings are based on recognizing patterns. (4-PS4-1)	**PS4.A: Wave Properties** ▪ Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2).* (4-PS4-1) ▪ Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ▪ Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ▪ Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	***Patterns*** • *Similarities and differences in patterns can be used to sort and classify natural phenomena.(4-PS4-1)* • *Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)* -- ***Connections to Engineering, Technology ,and Applications of Science*** ***Interdependence of Science, Engineering, and Technology*** *Knowledge of relevant scientific concepts and research findings is important in engineering.(4-PS4-3)*

4. Structure, Function, and Information Processing

Students who demonstrate understanding can**:**

4.PS4.2. Tier 2	**Develop a model to explain and discuss 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.]

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

4.LS1.1. Tier 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.]
D3.S4.C1.DPO1. Tier 1	**Describe the function of the following plant structures: roots-absorb nutrients, stems-provide support, leaves-synthesize food, flowers-attract pollinators and produce seeds for reproduction.**
D4.S4.C1.DPO1. Tier 2	**Compare structures in plants (e.g., roots, stems, leaves, flowers)**
D4.S4.C1.DPO2. Tier 1	**Compare structures in animals (e.g., muscles, bones, nerves) that serve different functions in growth and survival.**
4.LS1.2. Tier 1	**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.]of the skeletal
4.LS4.1.1 Tier 1	Identify the functions and parts of the skeletal system: protection- rib cage, cranium; support- vertebrae; movement- pelvis, femur, hip
4.LS4.1.2 Tier 1	Identify the following types of muscles: cardiac- heart; smooth- stomach; skeletal –biceps
4.LS4.1.3 Tier 1	Identify the functions and parts of the nervous system: control center –brain; relay mechanism – spinal cord; transport messages –nerves
4.LS4. 1.4 Tier 2	Distinguish between voluntary and involuntary responses.

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Recognize that in God's infinite wisdom He created all living creatures with senses that enable them to survive.
- Respect life at all stages, as a gift given freely by God.

Engineering Practices **Developing and Using Models** Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model to describe phenomena. (4.PS4.2) • Use a model to test interactions concerning the functioning of a natural system. (4.LS1.2) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model. (4.LS1.1)	**PS4.B: Electromagnetic Radiation** • An object can be seen when light reflected from its surface enters the eyes. (4.PS4.2) **LS1.A: Structure and Function** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4.LS1.1) **LS1.D: Information Processing** • Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4.LS1.2)	**Patterns** • Cause and effect relationships are routinely identified. (4.PS4.2) **Systems and System Models** A system can be described in terms of its components and their interactions. (4.LS1.1), (4.LS1.2)

4. Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:	
4.ESS1.1. **Tier 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 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 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. **Tier 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.]
4.S6.C2.DPO1. **Tier 1**	**Identify the Earth processes that cause erosion.**
4.S6.C2.DPO2. **Tier 1**	**Describe how currents and wind cause erosion and land changes.**
4.S6.C2.DPO3. **Tier 1**	**Describe the role that water plays in the following processes that alter the Earth's surface features: erosion, deposition, weathering.**
4.ESS2.2. **Tier 1**	**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.]
4.ESS3.2. **Tier 1**	**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 improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Evaluate the consequences of environmental occurrences that happen either rapidly or over a long period of time and how we are called in solidarity to help those involved in these events.
- Find out how students in your school can help families affected by a natural disaster. Plan a way to help.
- Become lifelong stewards who gratefully share the gifts of time, talent, and treasure.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4.ESS2.1) **Analyzing and Interpreting Data** Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning. (4.ESS2.2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Identify the evidence that supports particular points in an explanation. (4.ESS1.1) • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4.ESS3.2)	**ESS1.C: The History of Planet Earth** • Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4.ESS1.1) **ESS2.A: Earth Materials and Systems** • Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4.ESS2.1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the • boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4.ESS2.2) **ESS2.E: Bio geology** • Living things affect the physical characteristics of their regions. (4.ESS2.1) **ESS3.B: Natural Hazards** • A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards • but can take steps to reduce their impacts. (4.ESS3.2) (Note: This Disciplinary Core Idea can also be found in 3.WC.) **ETS1.B: Designing Solutions to Engineering Problems** • Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4.ESS3.2)	**<u>Patterns</u>** • <u>Patterns can be</u> used as evidence to support an explanation. (4.ESS1.1),(4.ESS2.2) **<u>Cause and Effect</u>** • Cause and effect relationships are routinely identified, tested and use to explain change. (4.ESS2.1),(4.ESS3.2) --- ***Connections to Engineering, Technology ,and Applications of Science*** ***Interdependence of Science, Engineering, and Technology*** **Influence of Engineering, Technology, and Science on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4.ESS3.2) ***Connections to Nature and Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural systems.** Science assumes consistent patterns and natural systems. (4.ESS1.1)

4. Engineering Design

Students who demonstrate understanding can:	
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.

Catholic Identity

- Share materials and work together in small groups, listen to the ideas of others. Be respectful and treat others as you wish to be treated.
- Use the God given gift of intellect to be resourceful and use simple tools to make tasks easier.
- Consider the pastoral as well as the practical nature of the problems and solutions we address.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5.ETS1.1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5.ETS1.3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5.ETS1.2)	**ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5.ETS1.1) **ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5.ETS1.2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5.ETS1.2) • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5.ETS1.3) **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5.ETS1.3)	**Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5.ETS1.1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5.ETS1.2)

Fifth Grade

The performance expectations in fifth grade help students formulate answers to questions such as:

- When matter changes, does its weight change?
- How much water can be found in different places on Earth?
- Can new substances be created by combining other substances?
- How does matter cycle through ecosystems?
- Where does the energy in food come from and what is it used for?
- How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?
- What miracles seem to exist in God's design of interworking ecosystems?

5. Structure and Properties of Matter

Students who demonstrate understanding can:	
5.PS1.1. **Tier 1**	**Create a model to explain that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]
5.S5.C1.DPO1. **Tier 1**	**Identify that matter is made of smaller units called: molecules and atoms.**
5.PS1.2. **Tier 1**	**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.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]
5.PS1.3. **Tier 1**	**Make observations and measurements to identify materials based on their properties.** [Clarification Statement: 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 Boundary: Assessment does not include density or distinguishing mass and weight.]
5.PS1.4. **Tier 1**	**Conduct an investigation to determine whether the mixing of two or more substances results in new substances.**
5S5.C1.DPO2. **Tier 1**	**Distinguish between mixtures and compounds.**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Discuss how evidence, observations, and logic are essential to scientific explanations, but not necessarily a part of belief based explanations (e.g. You don't need to see God to believe in Him.)
- Reference the story of Doubting Thomas who had to see the Risen Lord in order to believe. Faith, in any discipline, is believing and knowing without actually seeing.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. (5.PS1.1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5.PS1.4) • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5.PS1.3) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5.PS1.2)	**PS1.A: Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5.PS1.1) • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5.PS1.2) • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5.PS1.3) **PS1.B: Chemical Reactions** • When two or more different substances are mixed, a new substance with different properties may be formed. (5.PS1.4) • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5.PS1.2)	**Cause and Effect** • <u>Cause</u> and effect relationships are routinely identified, test, and used to explain change. (5.PS1.4) **Scale, Proportion, and Quantity** • Natural Objects exist from the very small to the immensely large. (5.PS1.1) • Standard units are used to measure and describe physical quantities such as weight, time, temperature, volume. (5.PS1.2),(5.PS1.3)

5. Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:	
5.PS3.1. **Tier 2**	**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.** [Clarification Statement: Examples of models could include diagrams, and flow charts.]
5.LS1.1. **Tier 1**	**Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]
5.LS2.1. **Tier 1**	**Create a model to describe the movement of matter among plants, animals, decomposers, and the environment.** [Clarification Statement: 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.] [Assessment Boundary: Assessment does not include molecular explanations.]
5.S4.C3.DPO5 Tier 2	**Explain the interrelationships among plants and animals in different environments: producers, consumers, decomposers. (Formerly 3.S4.C3.DPO5.)**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Understanding that all plants and animals are God's creation.
- Define and apply stewardship to all life on earth.
- Respect life at all stages, as a gift given freely by God.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena. (5.PS3.1) • Develop a model to describe phenomena. (5.LS2.1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model. (5.LS1.1) -- **Connections to Nature of Science** **Science Models, Laws, Mechanisms, and Theories** **Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events. (5.LS2.1)	**DPS3.D: Energy in Chemical Processes and PS3.D: Energy in Chemical Processes and Everyday Life** • The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5.PS3.1) **LS1.C: Organization for Matter and Energy Flow in Organisms** • Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5.PS3.1) • Plants acquire their material for growth chiefly from air and water. (5.LS1.1) **LS2.A: Interdependent Relationships in Ecosystems** • The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. • Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5.LS2.1) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** • Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5.LS2.1)	**Systems and System Models** **Systems and System Models** • A system can be described in terms of its components and their interactions. (5.LS2.1) **Energy and Matter** • Matter is transported into, out of , and within systems. (5.LS1.1) • Energy can be transferred in various ways and between objects. (5.PS3.1)

5. Earth Systems

Students who demonstrate understanding can:	
5.ESS2.1. Tier 1	**Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather 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 Boundary: Assessment is limited to the interactions of two systems at a time.]
5.ESS2.2. Tier 1	**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 Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]
5.S6.C3.DPO2. Tier 2	**Describe the distribution of water on the Earth's surface. (Formerly 4.S6.C3.DPO2.)**
5.ESS3.1. Tier 2	**Obtain and compare information about ways individual communities use science ideas to protect the Earth's resources and environment.**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Take this opportunity to develop an understanding of what it means to be responsible stewards of God's earthly gifts, both as individuals and as communities.
- Propose a solution, resource, or product that addresses a specific solution to protect the earth's resources and environment.
- Evaluate the possible strengths and weaknesses of a proposed solution relevant to protecting the earth's resources and environment.

Practices		
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an example to describe a scientific principle. (5.ESS2.1) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe and graph quantities such as area and volume to address scientific questions. (5.ESS2.2) **Obtaining, Evaluating, and communicating Information** Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5.ESS3.1)	**ESS2.A: Earth Materials and Systems** • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5.ESS2.1) **ESS2.C: The Roles of Water in Earth's Surface Processes** • Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5.ESS2.2) **ESS3.C: Human Impacts on Earth Systems** • Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5.ESS3.1)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight and volume. (5.ESS2.2) **Systems and System Models** • A system can be described in terms of its components and their interactions. . (5.ESS2.1),(5.ESS3.1) • -- ***Connections to Nature of Science*** • **Science Addresses Questions About the Natural and Material World** Science findings are limited to questions that can be answered within Empirical Evidence. (5. ESS3.1)

5. Space Systems: Stars and the Solar System

Students who demonstrate understanding can:	
5.PS2.1. **Tier 1**	**Support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the planet.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]
5.ESS1.1. **Tier 1**	**Support an argument that differences in the brightness of the sun compared to other stars is due to their relative distances from Earth.** [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]
5.ESS1.2. **Tier 1**	**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.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]
5.S.6.C2.DPO1. **Tier 1**	**Describe how the Moon's appearance changes during a four-week lunar cycle.**
5.S.6.C2.DPO2. **Tier 1**	**Describe how Earth's rotation results in day and night at any particular location.**
5.S.6.C2.DPO3. **Tier 1**	**Distinguish between revolution and rotation.**

Catholic Identity

- If students are using technology/devices, they should demonstrate Catholic responsibility through proper use of digital communication and apply digital citizenship.
- Students will relate Easter to the lunar cycle recognizing that Easter is held on the first Sunday After the first full moon occurring on or after the vernal equinox.
- Relate the story in Genesis to Earth's rotation resulting in day and night.
- Reference how the days get shorter during Advent in relation to winter solstice and shortest day of the year while waiting for the light of Christ as Christmas.

5. Engineering Design

Students who demonstrate understanding can:	
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.

Catholic Identity

- Share materials and work together in small groups, listen to the ideas of others. Be respectful and treat others as you wish to be treated.
- Use the God given gift of intellect to be resourceful and use simple tools to make tasks easier.
- Consider the pastoral as well as the practical nature of the problems and solutions we address.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified	**Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5.ETS1.1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-

(3-5.ETS1.1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5.ETS1.3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5.ETS1.2)	criteria for success or how well each takes the constraints into account. (3-5.ETS1.1) **ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5.ETS1.2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5.ETS1.2) • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5.ETS1.3) **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5.ETS1.3)	5.ETS1.2)

MIDDLE SCHOOL SCIENCE STANDARDS 6 – 8

2015

Diocesan Middle School: Physical Science

DMS- Structure and Properties of Matter

Students who demonstrate understanding can:	
DMS-PS1-1.	**Develop models to describe the atomic composition of simple molecules and extended structures (Tier 1)** Emphasize developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]
DMS-PS1-3.	**Collect and analyze information to describe that synthetic materials come from natural resources and impact society. (Tier 2)** Emphasize natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]
DMS-PS1-4.	**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. (Tier 1)** Emphasize qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
DMS-PS1-4.1.	**Investigate how the transfer of energy can affect the physical and chemical properties of matter (Tier 2)**
Catholic Identity	

Implementing Catholic Identity

- **Compare solutions that further the Christian goals to best address an identified need or problem.**
- **Define environmental stewardship and recognize it as part of Catholic social teaching.**
- **Discuss a sense of order, balance and symmetry in God's Universe i.e.…Water molecules symmetry/polarity**

Physical Science- Structure and Properties of Matter: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3).	**PS1.A: Structure and Properties of Matter (Tier 1)** • 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. (MS-PS1-1) • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.) • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) • 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. (MS-PS1-4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) **PS1.B: Chemical Reactions (Tier 1)** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.) **PS3.A: Definitions of Energy (Tier 2)** • The term "heat" as used in	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3) **Influence of Science, Engineering and Technology on Society and the Natural World** • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

	everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4) • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4)	

Diocesan Middle School: Physical Science

DMS- Chemical Reactions ***Students who demonstrate understanding can:***	
DMS-PS1-2.	**Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] (Tier 1)
DMS-PS1-2.1.	**Identify different kinds of matter based on the following physical properties: states, density, boiling point, melting point, solubility. (Tier 1)**
DMS-PS1-2.2.	**Identify different kinds of matter based on the following chemical properties: reactivity, pH, oxidation (corrosion)** (Tier 1)
DMS-PS1-2.3.	**Investigate how the transfer of energy can affect the physical and chemical properties of matter (Tier 2)**
DMS-PS1-2.4.	**Classify matter in terms of elements, compounds, or mixtures (homogeneous, heterogeneous mixtures) (Tier 1)**
DMS-PS1-2.5.	**Explain the systematic organization of the periodic table (Tier 1)**
DMS-PS1-5.	**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.** **(Tier 1)** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]
DMS-PS1-6.	**Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** **(Tier 2)** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]
DMS-PS1-	**Identify various ways in which electrical energy is generated using renewable and nonrenewable resources (e.g., wind, dams, fossil**

6.1.	**fuels, nuclear reactions). (Tier 2)**
DMS-PS1-6.2.	**Identify/ Explain several ways in which energy can be transformed, transferred or stored. (E.g. Batteries, mechanical to electrical, electrical to thermal, conduction, convection radiation.) (Tier 2)**

Catholic Identity

Integrating Catholic Identity

- **Define environmental stewardship in terms of renewable and non-renewable resources and recognize it as part of Catholic Social teaching.**
- **Evaluate the scientific evidence used in various media to address a social issue using criteria accuracy, logic, bias, relevance of data, credibility of sources, and discuss ethical implications.**
- **Discuss the perfection of God's Universe where the laws of chemistry can accurately predict future elements based on what we have discovered so far.**

Physical Science- Chemical Reactions: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS1-5) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) --------------------------------------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)	**PS1.A: Structure and Properties of Matter (Tier 1)** • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.) **PS1.B: Chemical Reactions (Tier 1)** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-5) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.) • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) Some chemical reactions release energy, others store energy. (MS-PS1-6) **ETS1.B: Developing Possible Solutions (Tier 1)** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) **ETS1.C: Optimizing the Design Solution (Tier 1)** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS-PS1-6)	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5) • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Diocesan Middle School: Physical Science
DMS- Forces and Interactions

Students who demonstrate understanding can:	
DMS-PS2-1.	**Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* (Tier 2)** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]
DMS-PS2-2.	**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. (Tier 1)** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]
DMS-PS2-3.	**Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (Tier 1)** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor. Because of the placement of this standard in the curriculum guide, teachers must be aware of student's potential confusion between gravity as a force and magnetism. Gravity is not a type of magnetism.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]
DMS-PS2-4	**Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (Tier 2)** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]
DMS-PS2-5.	**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. (Tier 2)** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]

Catholic Identity
Integrating Catholic Identity • Research and describe how forces and gravity affects the design of churches and tall cathedrals. i.e..... Domes, flying buttresses, columns, arches.

Physical Science- Forces and Interactions: Correlations to Minimum Standards

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

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Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between Variables, and clarifying arguments and models.

Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2)
Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-P 2-5)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)
Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical and
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PS2.A: Forces and Motion (Tier 1)

For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)
The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)
All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.(MS-PS2-2)

PS2.B: Types of Interactions (Tier 1)

Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)
Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)
Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)

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Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5)

Systems and System Models

Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4),

Stability and Change

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

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conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)		

Diocesan Middle School: Physical Science

DMS- Energy

Students who demonstrate understanding can:	
DMS-PS3-1.	**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. (Tier 1)** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball.]
DMS-PS3-1.1.	**Calculate velocity as the rate of change of position over time and create a graph devised from measurements of moving objects and their interactions including: position-time graphs, velocity-time graphs. (Tier 1)**
DMS-PS3-2.	**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. (Tier 1)** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]
DMS-PS3-3	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* (Tier 1)** [Clarification) Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
DMS-PS3-4.	**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. (Tier 2)** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
DMS-PS3-5.	**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.(Tier 2)** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

Catholic Identity
Integrating Catholic Identity • Define environmental stewardship in terms of renewable and non- renewable resources and recognize it as part of Catholic Social teaching.

- Evaluate the scientific evidence used in various media to address a social issue using criteria accuracy, logic, bias, relevance of data, credibility of sources, and discuss ethical implications.
- Discuss a sense of order, balance and symmetry in God's Universe. I.e... Law of Conservation of Energy and Mass
- Research explanations regarding the Shroud of Turin relating to how it was created.
- Find connections between Catholic researchers and their contributions to the study of energy.

Physical Science-Energy: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. Construct, use and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an	**PS3.A: Definitions of Energy (Tier 1)** • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2_ • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer (Tier 1)** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **PS3.C: Relationship Between Energy and Forces (Tier 1)** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) **ETS1.A: Defining and Delimiting an Engineering Problem (Tier 2)** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3)	**Scale, Proportion, and Quantity** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4) **Systems and System Models** • Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2) **Energy and Matter** • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3- 5) • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS- PS3-3)

explanation or a model for a phenomenon. (MS-PS3-5 --- **Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-4),(MS-PS3-5)		

DMS- Waves and Electromagnetic Radiation

Students who demonstrate understanding can:	
DMS-PS4-1.	**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. (Tier 1)** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]
DMS-PS4-2.	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. (Tier 1)** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]
DMS-PS4-3.	**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. (Tier 1)** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]
Catholic Identity	
• Demonstrate Catholic responsibility through proper use of digital communication and digital citizenship.	

Physical Science-Waves and Electromagnetic Radiation: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-PS4-2) **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. • Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3) --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)	**PS4.A: Wave Properties (Tier 1)** • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) • A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **PS4.B: Electromagnetic Radiation (Tier 1)** • 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. (MS-PS4-2) • 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. (MS-PS4-2) • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) **PS4.C: Information Technologies and Instrumentation** • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	**Patterns** • Graphs and charts can be used to identify patterns in data. (MS-PS4-1) **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2) • Structures can be designed to serve particular functions. (MS-PS4-3) --------------------------------------- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) --------------------------------------- ***Connections to Nature of Science*** **Science is a Human Endeavor** • Advances in technology influence the progress of science and science as influenced advances in technology. (MS-PS4-3)

Diocesan Middle School: Earth & Space Science

DMS- Space Systems

Students who demonstrate understanding can:	
DMS-ESS1-1.	**Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. (Tier 1)** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] Identify the major constellations visible from the Northern Hemisphere: Orion, Ursa Major (Great Bear), Cygnus (Swan), Scorpius, Cassiopeia.
DMS-ESS1-2.	**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. (Tier 1)** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy, Alpha Centauri and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]
DMS-ESS1-3.	**Analyze and interpret data to determine scale properties of objects in the solar system. (Tier 2)** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.

Catholic Identity

- Relate the liturgical calendar to the natural patterns of God's Universe.
- Appreciate the precision of the universal design which supports life on our planet. I.e. 23 degree tilt of the Earth, distance from the moon, placement of the Earth to the sun.
- Discuss physical laws as supported by the Old Testament. I.e. Genesis, Job.

Earth & Space Science - Space Systems: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine Similarities and differences in findings. (MS- ESS1-3)	**ESS1.A: The Universe and Its Stars (Tier 1)** • 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) • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and the Solar System (Tier 1)** • 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 t hem. (MS-ESS1- 2),(MS-ESS1-3) • 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) • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)	**Patterns** Patterns can be used to identify cause and affect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1- 3) **Systems and System Models** • Models can be used to represent systems and their interactions. (MS-ESS1-2) --- ***Connections to Engineering, Technology, and Applications of Science*** ***Interdependence of Science, Engineering, and*** **Technology** • Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS- ESS1-3) --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)

Diocesan Middle School: Earth & Space Science

DMS- History of Earth

Students who demonstrate understanding can:	
DMS-ESS1-4.	**Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 -billion-year-old history. (Tier 1)** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]
DMS-ESS2-2.	**Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (Tier 1)** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.
DMS-ESS-2.1	**Describe how people plan for, and respond to the following natural disasters: draught, flooding, tornadoes and hurricanes with an emphasis on our moral obligation to provide aid. (Tier 2)**
DMS-ESS2-3.	**Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. (Tier 1)** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).]
Catholic Identity	
• Awareness of Catholic services that provide aid to people in need from natural disasters and supporting their work. I.e.: Caritas Internationales, Catholic Relief Services, Catholic Charities, etc…	

Earth & Space Science - History of Earth: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS- ESS1-4),(MS-ESS2-2) ------------------------ ***Connections to Nature of Science*** **Scientific Knowledge is Open to Revision in Light of New Evidence** • Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)	**ESS1.C: The History of Planet Earth (Tier 1)** • 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) • Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) **ESS2.A: Earth's Materials and Systems (Tier 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) **ESS2.B: Plate Tectonics and Large-Scale System Interactions (Tier 1)** • 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) **ESS2.C: The Roles of Water in Earth's Surface Processes (Tier 1)** • Waters 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)	**Patterns** • Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) **Scale Proportion and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4),(MS-ESS2-2)

DMS- Earth's Systems

Students who demonstrate understanding can:	
DMS-ESS2-1.	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.(Tier 1)** [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.] deposition of rock).]
DMS-ESS2 - 4.	**Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.(Tier 1)** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]
DMS-ESS3-1.	**Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (Tier 2)** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]
DMS-ESS3-2	**Distinguish the components and characteristics of the rock cycle for the following types of rocks, igneous, metamorphic, sedimentary. (Tier 1)**
DMS-ESS3-3	**Identify the different spheres: Troposphere, stratosphere, mesosphere, thermosphere, ionosphere, exosphere. (Tier 2)**
Catholic Identity	
• Discuss the sense of order and balance of the Earth's systems in God's Creation.	

Earth & Space Science- Earth's Systems: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS2- 1) • Develop a model to describe unobservable mechanisms. (MS-ESS2-4) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)	**ESS2.A: Earth's Materials and Systems (Tier 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) **ESS2.C: The Roles of Water in Earth's Surface Processes (Tier1)** • 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) • Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) **ESS3.A: Natural Resources (Tier 1)** • Humans depend on Earths land, ocean, atmosphere, and biosphere for many different resources. 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)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1) **Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4) **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1) -- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has short and long- term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1)

Diocesan Middle School: Earth & Space Science
DMS- Weather and Climate

Students who demonstrate understanding can:	
DMS-ESS2-5.	**Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.(Tier 1)** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]
DMS-ESS2-6.	**Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (Tier 1)** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]
DMS-ESS3-5.	**Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. (Tier 1)** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

Catholic Identity

- Accept God’s creation with gratitude by moderating usage of resources.
- Define environmental stewardship in terms of resources and recognize it as part of Catholic social teaching.

Earth & Space Science - Weather and Climate: Correlations to Minimum Standards.

Science and Engineering Practices	**Disciplinary Ideas**	**Crosscutting Concepts**

Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions to identify and clarify evidence of an argument. (MS- SS3-5) **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS2-6) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)	**ESS2.C: The Roles of Water in Earth's Surface Processes (Tier 1)** • 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. (MS-ESS2-5) • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2- 6) **ESS2.D: Weather and Climate (Tier 1)** • 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) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) • 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) ESS3.D: Global Climate Change • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major 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)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) Systems and System Models • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6) Stability and Change • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Students who demonstrate understanding can:	
DMS-ESS3-2.	**Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (Tier 2)** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]
DMS-ESS3-3.	**Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* (Tier 2)** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
DMS-ESS3-3.1	**Students will demonstrate ways that they can have a positive impact on climate change by reducing their carbon footprint and being good stewards of the gifts that God gave us. (Tier 1)**

Catholic Identity

- Students will demonstrate ways that they can have a positive impact on climate change by reducing their carbon footprint and being good stewards of the gifts that God gave us.
- Students will recognize the need to help other countries in need during natural disasters through prayer and material donations.

Earth & Space Science - Human Impact: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS- ESS3-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)	**ESS3.B: Natural Hazards (Tier 2)** • Mapping 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) **ESS3.C: Human Impacts on Earth Systems (Tier 2)** • 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) • 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. (MS- ESS3-3),(MS-ESS3-4)	**Patterns** • Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2) **Cause and Effect** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3) • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-4) --- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-4) • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3) -- *Connections to Nature of Science* **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS- ESS3-4)

Students who demonstrate understanding can:	
DMS-LS1-1.	**Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. (Tier 1)** [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]
DMS-LS1-2.	**Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (Tier 1)** [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
DMS-LS1-2.1	**Describe how single-celled and multi-celled organisms carry on basic life processes. Ex… osmosis, diffusion. (Tier 1)**
DMS-LS1-3.	**Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (Tier 1)** [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, reproductive and nervous systems.]
DMS-LS1-4.	**Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.(Tier 2)** [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]
DMS-LS1-5	**Identify ways in which living things can be classified. (Tier 1)** E.g. Taxonomic groups of plants, animals, and fungi; groups based on details of organism's internal and external features; groups based on functions served within an ecosystem such as producers, consumers, and decomposers.
DMS-LS1-6	**Relate the following structures to their functions for plants. (Tier 1)** Transpiration- stomata, roots, xylem, phloem. Absorption-roots, xylem, phloem, Response to stimulus-phototropism, hydrotropism, geotropism, gravitropism. Dormancy, pollination, seed dispersal.

Catholic Identity

- Use argument supported by evidence to discriminate between life-affirming technology and reckless technological progress.
  - Embryonic Stem Cells
  - Human Genetic Modification
  - Cloning
- Demonstrate a respect for the human body through personal choices such as:
  - Refraining from the ingestion of harmful chemicals
  - Practicing regular exercise, healthful eating and proper hygiene
  - Practicing chastity
  - Getting adequate amounts of sleep.

Life Science - Structure, Function and Information Processing: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-LS1-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K- 5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) **Obtaining, Evaluating, and communicating Information** Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not	**LS1.A: Structure and Function (Tier 1)** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells multicellular). (MS-LS1-1) • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.D: Information Processing (Tier 2)** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1- 8)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) **Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) **Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures /systems can be analyzed to determine how they function. (MS-LS1-2) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1- 1) --- ***Connections to Nature of Science*** **Science is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

supported by evidence. (MS-LS1-8)		

Diocesan Middle School: Life Science

DMS- Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:	
DMS-LS1-6.	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (Tier 1)** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]
DMS-LS1-7.	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (Tier 1)** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]
DMS-LS2-1.	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (Tier 1)** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]
DMS-LS2-3.	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (Tier 1)** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems (Biomes), and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]
DMS-LS2-4.	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (Tier 1)** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Catholic Identity

- Appreciate God's Creation through the vigilant care of our surroundings.
- Practice the virtue of temperance through the moderate use of resources.
- Discuss the sense of order, balance, biological diversity and interconnectedness of God's Universe i.e. food webs, nitrogen cycle, carbon cycle.
- Perform acts of good stewardship.

Life Science - Matter and Energy in Organisms and Ecosystems: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe phenomena. (MS-LS2-3) • Develop a model to describe unobservable mechanisms. (MS-LS1-7) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-6)	**LS1.C: Organization for Matter and Energy Flow in Organisms (Tier 1)** • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) **LS2.A: Interdependent Relationships in Ecosystems (Tier 1)** • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2- 1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems (Tier1)** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS- LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5),(MS-LS4- 5) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and use to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)

Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K– 5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4) --- -------***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence • Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6) • Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience (Tier 2)** • 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) **PS3.D: Energy in Chemical Processes and Everyday Life (Tier 2)** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)	--- ***Connections to Nature of Science*** ***Science Addresses Questions About the Natural and Material World*** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

Diocesan Middle School: Life Science

DMS- Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:	
DMS-LS2-2.	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (Tier 1)** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]
DMS-LS2-2.1	**Compare the symbiotic and parasitic relationships in organisms within an ecosystem. (Tier 2)**
DMS-LS2-5.	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* (Tier 2)** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

Catholic Identity

- Discuss the sense of order, balance, biological diversity and interconnectedness of God's Universe i.e. food webs, symbiotic relationships.
- Accept God's creation with gratitude by moderating usage of resources.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)	**LS2.A: Interdependent Relationships in Ecosystems (Tier 1)** • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience (Tier 2)** • Biodiversity describes the variety of species found in Earths 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) **LS4.D: Biodiversity and Humans (Tier 2)** • 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) **ETS1.B: Developing Possible Solutions (Tier 2)** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	**Patterns** • Patterns can be used to identify cause and affect relationships. (MS-LS2-2) **Stability and Change** • Small changes in one part of a system might cause large changes in another part. (MS-LS2-5) --------------------------- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS- LS2-5) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Diocesan Middle School: Life Science

DMS- Growth, Development, and Reproduction in Organisms

Students who demonstrate understanding can:	
DMS-LS1-4.	**Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. (Tier 2)** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]
DMS-LS1-5.	**Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (Tier 1)** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]
DMS-LS3-1.	**Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. (Tier 1)** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]
DMS-LS3-2.	**Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. (Tier 1)** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]
DMS-LS3-2.1	**Explain the purposes of cell division: growth and repair and reproduction. (Tier 1)**
DMS-LS3-2.2	**Explain basics of mitosis and meiosis (Tier 1)**
DMS-LS3-2.3	**Explain the basic principles of heredity using the human examples of eye color, widows peak, blood type (Tier 1)**
DMS-LS3-2.4	**Distinguish between the nature of dominant and recessive traits in humans. (Tier 1)**
DMS-LS4-5.	**Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.(Tier 2)** [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have

	on society as well as the technologies leading to these scientific discoveries.]
DMS-LS4-5.1	**Discuss the Church's stance regarding: immorality of artificial insemination, contraception, sterilization, and bioengineering including: cloning, embryonic stem cell research, genetic engineering. (Tier 2)**

Catholic Identity

- Use argument supported by evidence to discriminate between life-affirming technology and reckless technological progress such as:
    - Embryonic Stem Cells
    - Human Genetic Modification
    - Cloning
- Demonstrate a respect for the human body through personal choices such as:
    - Refraining from the ingestion of harmful chemicals
    - Practicing regular exercise, healthful eating and proper hygiene
    - Practicing chastity
    - Getting adequate amounts of sleep.
    - Limiting exposure to radiation (solar and x-rays)

Life Science - Growth, Development, and Reproduction in Organisms: Correlations to Minimum Standards

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS- LS3-1),(MS-LS3-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed	**LS1.B: Growth and Development of Organisms (Tier 1)** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.(secondary to MS-LS3-2) • Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4 • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) • Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) **LS3.A: Inheritance of Traits (Tier 1)** • 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. 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) • 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) **LS3.B: Variation of Traits (Tier 1)** • 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	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. MS- LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5),(MS-LS4- 5) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

	or may differ from each other. (MS-LS3-2) 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) **LS4.B: Natural Selection (Tier 1)** • In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined	

Diocesan Middle School: Life Science

DMS- Natural Selection and Adaptations

Students who demonstrate understanding can:	
DMS-LS4-1.	**Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. (Tier 2)** [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]
DMS-LS4-2.	**Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (Tier 2)** [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]
DMS-LS4-3.	**Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.(Tier 2)** Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]
DMS-LS4-4.	**Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. (Tier 1)** [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations
DMS-LS4-6.	**Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. (Tier 1)** [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

Catholic Identity

- Reference St. John Paul II 1996 message to the Pontifical Academy of Sciences & Pope Pius XII on 1950 encyclical Humani Generis on evolution.
- Use argument supported by evidence to discriminate between life-affirming technology and reckless technological progress such as:

- Embryonic Stem Cells
- Human Genetic Modification
- Cloning
- Eugenics

Life Science - Natural Selection and Adaptations: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts

Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation and basic statistical techniques of data and error analysis. • Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3) • Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4- 2) • Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)	**LS4.A: Evidence of Common Ancestry and Diversity (Tier 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) • Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) • Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) **LS4.B: Natural Selection (Tier 1)** • Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) **LS4.C: Adaptation (Tier 1)** • 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)	**Patterns** • Patterns can be used to identify cause and affect relationships. (MS-LS4-2) • Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1), (MS-LS4-3) **Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4- 4),(MS-LS4-6) --- ***Connections to Nature of Science*** *Scientific Knowledge Assumes an* Order and Consistency in Natural Systems • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1),(MS-LS4-2)

Diocesan Middle School: Engineering

DMS- Engineering Design

Students who demonstrate understanding can:	
MS-ETS1-1.	**Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (Tier 1)**
MS-ETS1-1.1	**Explain the ethics and morality associated with scientific study and engineering design.(Tier 1)**
MS-ETS1-2.	**Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (Tier 1)**
MS-ETS1-3.	**Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (Tier 1)**
MS-ETS1-4.	**Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (Tier 1)**

Catholic Identity

- Explain the ethical and moral responsibilities associated with scientific study and engineering design
- Understanding the importance of an Internal Review Board (IRB) for the Ethical practices in experimentation
- Demonstrate personal integrity
- Outline the ethical constrains and considerations in regards to possible solutions to a problem
- Demonstrate respect and consider different ideas with compassion, justice and kindness
- Research the historical contributions of Catholic scientists. (Albertus Magnus, Roger Bacon, Gregor Mendel, etc...)

Engineering - Engineering Design: Correlations to Minimum Standards.

Science and Engineering Practices	Disciplinary Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1) **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS- ETS1-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ET	**ETS1.A: Defining and Delimiting** Engineering Problems (Tier 1) • The more precisely a design tasks criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1- 1) **ETS1.B: Developing Possible Solutions (Tier 1)** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.(MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS- ETS1-4) **ETS1.C: Optimizing the Design Solution (Tier 1)** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	**Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

Diocesan Middle School: Engineering

DMS- The Scientific Process

Students who demonstrate understanding can:	
DMS-TSP1-1.	**OBSERVING: Use the senses to gather information about objects and events in the environment. This skill includes using scientific instruments to extend the range of the human senses and the ability to differentiate relevant from non-relevant.**
DMS-TSP1-2.	**INFERRING: An inference is a tentative explanation that is based on partial observations.** **Available data is gathered and an evaluation made based on the observed data. These judgments are never absolute and reflect what appears to be the most probable explanation at the time and are subject to change as new data is accumulated.**
DMS-TSP1-3.	**QUESTIONING: The formulating of original questions based on observations and experiences with an event in such a way that one can experiment to seek the answers.**
DMS-TSP1-4.	**FORMULATING HYPOTHESIS: Stating a probable outcome for an occurrence based on observations and inferences. The validity of the hypothesis is determined from testing of data analysis.**
DMS-TSP1-5.	**EXPERIMENTAL DESIGN: The process is the culmination of all the science process skills.** **Experimentation often begins with observations, which lead to questions that need answers. The steps for proceeding may include forming a hypothesis, identifying and controlling dependent and independent variables, designing the procedure for conducting tests, implementing tests, collecting and interpreting the data and reaching a conclusion.**
DMS-TSP1-6.	**MEASURING: Use instruments to determine the length, area, volume, mass, temperature, density** **or other physical properties of an unknown quantity in SI units.**
DMS-TSP1-7.	**ORGANIZING AND ANALYZING DATA: Reveal patterns and relationships in data through tabulating, graphing or statistical analysis.**
DMS-TSP1-8.	**COMMUNICATING: Clearly and persuasively transmit the results of observations and experimental procedures to others through the use of graphs, charts, tables, written descriptions, technology, oral presentations, expository writing, etc.**

Catholic Identity

- Understanding the importance of an IRB for the Ethical practices in experimentation
- Demonstrate personal integrity
- Outline the ethical constrains and considerations in regards to possible solutions to a problem

- Demonstrate respect and consider different ideas with compassion, justice and kindness
- Research the historical contributions of Catholic scientists. (Albertus Magnus, Roger Bacon, Gregor Mendel, etc...)

APPENDICES

APPENDIX 1 – LAB REPORT GRADING RUBIC

20 points possible

MLA format:___1 point

possible Lab Title: _

Section Headings: __

Introduction:

1) Statement of problem (answering the question "what was investigated?"):_______3 points possible Comments:

2) Statement of purpose (answering the question "why was this problem studied?"):______3 pts possible Comments:

3) Background information (what information does the reader need to know to understand the lab?):
   ____4 points possible
   ____Definitions of all scientific terms used
   ____Scientific laws described and explained
   ____All formulas and units described and explained Comments:

4) General method (a one-sentence summary of how the lab was done):_______3 points possible Comments:

5) Expected results and hypothesis (what did the author expect the outcome to be, and why?):
   ____4 points possible Comments:

Method & Materials, Results, and Conclusion:_included, 1 point possible Comments:

References:____, 1 point possible

Total points earned: ____

Lab Report Guide

1) What is the lab title? ____
2) Include each section's heading: Introduction, Methods & Materials, Results, Conclusion
3) The introduction should include:
a) a statement or description of what was investigated:
i) ___________
b) An explanation of why that phenomenon was being studied:
i) ___________
c) How the problem was investigated in a one or two sentence description of the method:
i) ___________
d) Pertinent background information:
i) What further information is needed to understand what is happening in the lab?

____

____

ii) What technical terms are used to describe scientific laws in action, procedures in the lab, observations, etc.?_______
iii) What laws and terms need to be defined? ____
iv) What formulas are used? What do those formulas mean? __________________________________
e) A description of the person's expectations for their results and/or a hypothesis:
i) What was expected to happen? Why? ____

____

4) The methods and materials section should include both the method and a complete list of materials:
a) List the method, and note any changes, gaps, or inconsistencies in the procedure:

____

b) Was the procedure written as a set of instructions, in the present tense? For example, "first, obtain the needed reactants." yes no
i) If so, rewrite the first step as a description of what was done, in past tense. For example, "first, the needed reactants were obtained." ____

____

c) Note any missing materials – is anything discussed in the procedure, but not listed in the materials?
If so, add them. ____

5) When the results section provides a data table or graph, are the data also described in full sentences? If not, add them.

a) Consider all data. Describe all connections and relationships between quantitative and qualitative data. For example, "at 8 degrees Celsius, all ice had melted."

b) Using the titles of graphs or charts, describe what the graph or chart shows.

6) Does the results section include any statements comparing or drawing conclusions about the data? For example, "the first chemical was the most reactive" or "these results show that some chemicals are reactive and some are not." Underline these statements to show which sentences need to be moved to the conclusion section.

7) The conclusion section should:

a) reflect on whether the expected results or hypothesis in the introduction were observed or supported? Give an explanation of why the hypothesis was either supported or not supported:

b) include responses to the analysis and conclusion prompts in the lab packet.

c) reflect on the procedure used this lab? What should be done differently if the lab were to be repeated? What might have affected the accuracy of the data?

8) Correct grammar for 3rd person passive tense:

a) Reread the paper, and circle all pronouns: I, you, he, she, they, we, my, yours, ours, theirs

b) In the first sentence using I, we, my, our, change the sentence so the sentence reads "x, y, and z were done."

c) Avoid 3rd person active constructions, such as "the student observed a gas." This sentence should be "A gas was observed."

d) Fix all mistakes.

9) Include all references, or sources of information, used in this lab, including the textbook and any websites. List in MLA format.

Lab Report Proofreading and Revision Guide

1) Does the report have a lab title? yes no
2) Does the report have an introduction, a single method and materials section, a results section, and a conclusion? List any missing:

____

a) Does each section have a heading? yes no

3) Does the introduction include:

a statement or description of what was investigated? yes no

What was it?

____

b) An explanation of why that phenomenon was being studied? yes no

i) Which was?

____

c) How the phenomenon was investigated in a short recap of the method? yes no

i) What was done?

____

d) Pertinent background information? yes no

i) is there further information that would be helpful to you, as the reader, in understanding what this person was doing? If so, what?

____

____

e) A description of the person's expectations for their results and/or a hypothesis? yes no

i) What were their expected results?

____

____

4) Does the methods and materials section include both the method and a complete list of materials? yes no If no, what is missing?

____

a) Read the method, and note any questions you have about apparent gaps or inconsistencies in the procedure:

____

b) Was the procedure written as a set of instructions, in the present tense? For example, “first, obtain the needed reactants.” yes no

i) If so, rewrite the first step as a description of what was done, in past tense. For example, "first, the needed reactants were obtained."

____

____

c) Note any missing materials – is anything discussed in the procedure, but not listed in the materials? yes no

____

5) If the results section provides a data table or graph, are the data also described in full sentences? yes no

6) Does the results section include any statements comparing or drawing conclusions about the data? For example, "the first chemical was the most reactive" or "these results show that some chemicals are reactive and some are not." Underline these statements to show which sentences need to be moved to the conclusion section.

7) Does the conclusion section:

a) reflect on whether the expected results or hypothesis in the introduction were observed or supported? Does the author give an explanation of why the hypothesis was either supported or not supported? If not, provide them with a short explanation based on your reading of the lab report:

____

b) include responses to the analysis and conclusion prompts in the lab packet? yes no

c) reflect on the procedure the student designed for this lab? What would they do differently if they were to repeat the lab?

____

8) Correct grammar for 3rd person passive tense:

a) Reread the paper, and circle all pronouns: I, you, he, she, they, we, my, yours, ours, theirs

b) In the first sentence using I, we, my, our, change the sentence so the sentence reads "x, y, and z were done."

c) Avoid 3rd person active constructions, such as "the student observed a gas." This sentence should be "A gas was observed."

d) Fix as many sentences as possible.

9) Additional comments:

APPENDIX 2 – SAMPLE FORMAT FOR SCIENTIFIC WRITING

Lab Format for an Introductory Science Lab Course

Include the following 10 parts unless otherwise instructed. (Point values are discretionary)

1. **Testable Question:** (*Think: What am I attempting to answer?)* **1 pts**

A question you can attempt to find the answer to in one experiment.
The typical question format is:
How is_________related to________?

2. **Hypothesis:** *(Think: What do I predict the answer is?)* **1 pts**

Use format: If … and … then …

3. **Variables:** *(Think: What am I going to measure?)* **3 pts**

List all the variables in your experiment.
Identify the nature of each variable (independent, dependent, control, etc.).

4. **Design:** *(Think: Organized and detailed plan.)* **3 pts**

This is a blueprint / layout of the planned measurements.
It takes the form of a table.
Order: Controls, independent variable, dependent variable
Example:

mass	distance	angle	time
m1	d1	a1-a8	t1-t8
m2	d1	a1-a8	t1-t8
m1	d2	a1-a8	t1-t8
etc.	etc.	etc.	etc.

Each line describes a set of data: For one mass (m1) and one distance (d1) (controls) the time (t) (Dependent Variable [DV]) will be measured for 8 different values of the angle (a1-8) (Independent Variable [IV]). We usually only have the first line, but another group will usually have different controls and thus appear to be doing the next lines.

5. **Materials:** *(Think: What do I need?)* **1 pt**

List the essential materials, but avoid the obvious such as paper and pencil.

6. **Procedure:** *(Think: How will I do it?)* **1 pt**

Give step-by-step instructions. Be brief and precise.
Use a drawing to illustrate the setup.

7. **Data:** *(Think: What did I measure?)* **3 pts**

Make a data table with all your measurements. Make sure to include your controls. Use metric units. The use of metric prefixes is allowed.

Use the correct number of significant figures for your measurement.

8. **Analysis:** *(Think: Graphs and/or calculations?)* **6 pts**

Generally the independent variable is graphed on the x-axis and the dependent variable is graphed on the y-axis. Follow these rules for graphs:

- Title should reflect variables measured
- Labels and units on both axes
- Choose scales to fill out the graph paper (graph breaks where appropriate)
- Use consistently spaced scales
- Mark each data point clearly

Draw the best straight line through the points (if applicable) and find the slope.

9. **Conclusion:** *(Think: Answer the question in 1.)* **2 pts**

Answer the testable question in as precise a language as possible.

10. **Evaluate your results:** *(Think: Are they good? Do I trust my own results?)* **3 pts**

- Did you get the expected relationship?
- Was the original hypothesis supported by your data?
- Was the lab well designed, did the procedure work to test your hypothesis?
- Can you think of ways to improve it?
- Additional questions may be posed by the teacher specific to the particular lab.

******The following is an example of a lab format for a biology course.**

Title: Usually taken from lab worksheet

PROBLEM: *Always written in the form of a question*

Or

OBJECTIVE: *Statement of the purpose of the lab*

HYPOTHESIS: *If the lab is experimental a hypothesis is always included. This is simply a testable statement related to what you believe the results of an experiment should be:*

IF, AND, THEN - STATEMENTS:

If - restates the hypothesis in simpler terms

And - Describes the test to prove hypothesis

Then - Prediction of expected results

EXPERIMENTAL DESIGN: If there is a control in the experiment then the Independent (IV), Dependent (DV) and Controlled (CV) variables must be listed here.

- **IV –** the part of the experiment that is change on purpose (includes a control set-up)
- **DV –** The part of the experiment that is affected by the independent Variable
- **CV –** All the other items of the experiment that are used in each set-up

******If the experiment is simply an observation of an object (or phenomenon) then one simply states next to the Experimental Design – NO CONTROL and lists the materials needed for the experiment. (That is: If the experiment does not have an independent or dependent variable then simply list the materials to be used.)

PROCEDURE: Most experiments already have listed procedures (written in third person). In this case the student should *summarize the steps as if he/she were explaining to someone what they are about to do. ** If the student is designing the experiment on their own then precise directions should be written.*

DATA: (table and/or graph) *Data will be collected, recorded, and graphed (sometimes you will use the lab worksheet provided and other times you will need to create your own table and graphs). IF you use the lab worksheet, please cite the source that directs the reader to that information:* i.e. See attached Data Chart and Graphs

ANALYSIS:

- Students must describe their results using only concrete details (i.e. data, interpretations of graph)
- ALSO students must answer questions on a lab handout if supplied.

CONCLUSION: Must refer to your original hypothesis.

- Include a comparison statement to your original hypothesis.
- Supply data from the lab as support/refuting hypothesis
- If hypothesis was refuted, the student must supply a revised hypothesis

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Lab formats for each successive year in High School will take on different formatting but include the same information. One example is a different focus on Data collection (i.e. more observational for biology – forms of diagrams of results)

Student and Teacher Templates may also be found on the AP college board website.

APPENDIX 3

- HEALTH CARE DIRECTIVES FROM THE UNITED STATES CONFERENCE OF CATHOLIC BISHOPS

The following directives have been selected as specific examples pertinent to Diocesan Concept 3 and Strand 3 Diocesan Concept 4. To see the directives in their entirety, go to www.ncbcenter.org/C_D_directives.asp

Directive 36: While every person is obliged to use ordinary means to preserve *his/her* health, no person should be obliged to submit to a health care procedure that the person has judged, with a free and informed conscience, not to provide a reasonable hope of benefit without imposing excessive risks and burdens on the patient or excessive expense to family or community.

Directive 52: Catholic health institutions may not promote or condone contraceptive practices but should provide, for married couples and the medical staff… instruction both about the Church's teaching on responsible parenthood and in methods of natural family planning."

Directive 53: Direct sterilization of either men or women, whether permanent or temporary, is not permitted in a Catholic health care institution. Procedures that induce sterility are permitted when their direct effect is the cure or alleviation of a present and serious pathology and a simpler treatment is not available.

Directive 56: A person has a moral obligation to use ordinary or proportionate means of preserving *his* or *her* life. Proportionate means are those that in the judgment of the patient offer a reasonable hope of benefit and do not entail an excessive burden or impose excessive expenses on the family or community.

Directive 57: A person may forgo extraordinary or disproportionate means of preserving life. Disproportionate means are those that in the patient's judgment do not offer a reasonable hope of benefit or entail an excessive burden, or impose excessive expense on the family or community.

Directive 58: There should be a presumption in favor of providing nutrition and hydration to all patients, including patients who require medically assisted nutrition and hydration, as long as this is of sufficient benefit to outweigh the burdens involved to the patient.

Directive 60: Euthanasia is an action or omission which of itself or by intention causes death, in order to alleviate suffering. Catholic health care institutions may never condone or participate in euthanasia or assisted suicide in any way. Dying patients who request euthanasia should receive loving care, psychological and spiritual support, and appropriate remedies for pain and other symptoms so that they can live with dignity until the time of natural death.

Directive 61: Patients should be kept as free of pain as possible so that they may die comfortably and with dignity . . . Since a person has the right to prepare for his or her death while fully conscious, he or she should not be deprived of consciousness without a compelling reason....

Directive 63: Catholic health care institutions should encourage and provide the means whereby *those who wish to do so* may arrange for the donation of their organs and bodily tissue, for ethically legitimate purposes, so that they may be used for donation and research after death.

APPENDIX 4 LIST OF BOOKS

Fiction:

Periodic Table Mysteries Series,	Minichino, Camille
A Swiftly Tilting Planet	L'Engel, Madeleine
A Wrinkle in Time	L'Engel, Madeleine

Nonfiction:

A Swiftly Tilting Planet	L'Engel, Madeleine
A Wrinkle in Time	L'Engel, Madeleine
Collapse	Diamond, Jared
Finding Darwin's God	Miller, Kenneth Gulf,
The Adventures of Alimentary Canal	Roach, Mary
Half the Sky	Kristoff, N. and WuDunn, S.
Periodic Table Mysteries Series,	Minichino, Camille
Plan B 4.0	Brown, Lester
Silent Spring	Carson, Rachel
Song for the Blue Ocean	Safina, Carl Stiff,
The Curious Lives of Cadavers	Roach, Mary The
Disappearing Spoon	Kean, Sam
The Double Helix	Watson, James The
Immortal Life of Henrietta Lacks	Skloot, Rebecca The
Man Who Mistook His Wife for a Hat	Sacks, Oliver The
Omnivores Dilemma	Pollan, Michael
The Story of Stuff	Leonard, Annie
Uncle Tungsten	Sacks, Oliver

APPENDIX 5 GLOSSARY

The purpose of this glossary is to help the user better understand and implement the Diocesan Science Standards of the Diocese of Tucson. It is not intended to be an exhaustive list of all scientific terms.

abiotic	Nonliving
absorb	to take up (e.g., plant roots absorb water)
adaptation	hereditary features of organisms that allow them to live in a particular environment
affect	to have an influence on
affluence	plentiful supply of material goods; wealth
analyze	to examine methodically by separating into parts and studying their interrelations
applied science	research aimed at answering questions that have practical applications, e.g., determining the causes of diseases so that cures might be found
asteroid	small rocky body orbiting the Sun
atmosphere	gaseous envelope surrounding the Earth
atom	smallest particle of an element that retains the chemical nature of the element
barometric pressure	atmospheric pressure as indicated by a barometer, used especially in weather forecasting
basic science	research designed to describe or explain nature to satisfy one's curiosity
bias	statistical sampling or testing error caused by systematically favoring some outcomes over others
biodiversity	1. number and variety of organisms found within a specified geographic region 2. variability among organisms, including the variability within and between species and within and between ecosystems
biome	broad area of the Earth's surface characterized by distinctive vegetation and associated animal life; e.g., broad-leaf forest biome, grassland biome, desert biome
biotic	relating to life or living organisms
calorimetric	relating to the measurement of heat energy by means of temperature measurements
camouflage	concealment by disguise or protective coloring
carrying capacity	maximum number of individuals that a given environment can support for a sustained period of time

catalyst	substance, usually used in small amounts relative to the reactants, that modifies and increases the rate of a reaction without being consumed in the process
celestial	of or in the sky or universe, as planets or stars
cell membrane	The thin membrane that forms the outer surface of the protoplasm of a cell and regulates the passage of materials in and out of the cell. It is made up of proteins and lipids and often contains molecular receptors.
cell wall	The definition of a cell wall is the protective coating for a plant cell.
cellular respiration	metabolic processes which break down nutrients into usable energy
circuit	1. closed path followed or capable of being followed by an electric current 2. configuration of electrically or electromagnetically connected components or devices
cirrus	high-altitude cloud composed of narrow bands or patches of thin, generally white, fleecy parts
Characteristic	distinguishing trait, feature, quality, or property
chloroplasts	A plastid in the cells of green plants and green algae that contains chlorophylls and carotenoid pigments and creates glucose through photosynthesis.
cladistics	system of classification that constructs evolutionary trees, showing how shared derived characters can be used to reveal degrees of evolutionary relationships between existing and extinct species
classification	system method of organization of objects or organisms using distinct characteristics or features classify to arrange or organize according to class or category
Climate	average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity and precipitation
Comet	body of dust, ice, and gas, which orbits the Sun; the orbit is usually highly elliptical or even parabolic
Communicate	to convey information about; make known; express oneself in such a way that one is readily and clearly understood
Community	group of plants and animals living and interacting with one another in a specific region under relatively similar environmental conditions
Compare	to examine in order to note the similarities or differences of
Compound	substance formed from two or more elements chemically united in fixed proportions
Conclusion	statement, or statements, that summarize the extent to which hypotheses have been supported or not supported

Conduction	process by which heat or electrical energy is transmitted through a material or body without gross motion of the medium itself
Conifer	any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnosperm trees or shrubs such as pines, spruces, and firs
Conservation	Life science: the protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soil, and water, to prevent exploitation, destruction or neglect
	Physical science: a unifying principle of constancy of a quantity under specified conditions
Constellation	formation of stars perceived as a figure or design, especially one of 88 recognized groups named after characters from classical mythology and various common animals and objects
Consumer	organisms requiring complex organic compounds for food, which is obtained by preying on other organisms or by eating particles of organic matter
Contrail	artificial cloud created by an aircraft, caused either by condensation due to the reduction in air pressure above the wing surface, or by water vapor in the engine exhaust
Controlled Investigation	investigation in which all but one variable remain constant
Convection	transfer of heat energy in a gas or liquid by the circulation of currents of matter from one region to another
Crystallization	to cause to form crystals or take on a crystalline structure
Cumulus	dense, white, fluffy, flat-based cloud with a multiple rounded top and a well-defined outline, usually formed by the ascent of thermally unstable air masses
Data	factual information, from observations, organized for analysis
Decomposer	organisms such as bacteria and fungi that feed and break down dead organisms, returning constituents of organic substances to the environment
Deformation	alteration of shape, as by pressure or stress
Demonstrate	to prove or make evident by reasoning or adducing evidence
Deposition	act of depositing, especially the laying down of matter by a natural process something deposited; a deposit
Describe	to transmit a mental image or impression with words
Distinguish	to perceive or indicate differences; discriminate
Dominant	of, relating to or being an allele that produces the same phenotypic effect whether inherited with a homozygous or heterozygous allele
DNA	(Deoxyribonucleic acid) double strand of nucleotides that is a self-replicating molecule present in living organisms as the main constituent of chromosomes; contains the genetic code and transmits the heredity pattern

Ecology	study of the interactions and relationships between and among organisms and their environment
Ecosystem	all the organisms in a given area and the abiotic factors with which they interact
Eclipse	partial or complete obscuring, relative to a designated observer, of one celestial body by another
E.g.	abbreviation for example; precedes a non-exhaustive list of examples provided as options; other examples may be appropriate but not included (compare to i.e.)
Electron	negatively charged fundamental particle in an atom
element	any of more than 100 fundamental substances that consist of atoms of only one atomic number and that singly or in combination constitute all matter
Environment	sum of all external conditions affecting the life, development and survival of an organism, including the biotic (living) and abiotic (non-living) elements
Erosion	group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the Earth's surface
Eukaryotic	referring to a cell with a nucleus and other internal structure
Evaluate	to examine and judge carefully; appraise
Experimentation	act of conducting a controlled test or investigation
Extinct	no longer in existence
Fertilization	1. Act or process of initiating biological reproduction by insemination or pollination 2. Union of male and female gametes to form a zygote
Food chain	arrangement of the organisms of an ecological community according to the order of predation in which each uses the next as a food source
Food web	totality of interacting food chains in an ecological community
Force	K-6: push or pull that change the motion or shape of an object 7- HS: vector quantity that tends to produce an acceleration of a body in the direction of its application
Formulate	to devise or invent
Frequency	ratio of the number of times an event occurs in a series of trials of a chance experiment to the number of trials of the experiment performed; the number of cycles an oscillating system executes in one second
Friction	force that resists relative motion between two bodies in contact
Front (weather)	interface between air masses of different temperatures or densities
Gas	state of matter that does not have a definite shape or volume and is much less dense than a liquid because its molecules are far apart compared to their diameters
Genotype	particular combination of genes in an organism

Geoscience	the geological sciences as a whole; geology
Gravitation	universal force by which everybody in the universe attracts every other body
Gravity	attraction of the mass of the Earth, the Moon or a planet for bodies at or near its surface
Greenhouse gas	atmospheric gas such as carbon dioxide, water vapor, and methane that allows incoming sunlight to pass through but absorbs infrared radiation radiated back from the Earth's surface, leading to the phenomenon whereby the Earth's atmosphere traps solar radiation
Guided investigation	teacher-directed investigation
Habitat	place or environment where a plant or animal naturally or normally lives and grows
Hazardous waste	substance, such as nuclear waste or an industrial byproduct, that is potentially damaging to the environment and harmful to humans and other organisms
Heredity	genetic transmission of characteristics from parent to offspring
Heterogeneous	consisting of dissimilar elements or parts
Homogeneous	uniform in structure or composition throughout
hydrosphere	aqueous envelope of the Earth, including the oceans, all lakes, streams, and underground waters, ice, and the aqueous vapor in the atmosphere
Hydrologic	the science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.
Hypothesis	statement of an anticipated result of an investigation proposed relationship among observable phenomena or an inferred explanation for those phenomena
Identify	to find out the origin, nature, or definitive elements of
I.e.	abbreviation for that is; precedes a specific list of items in which all of the items should be used (compare to e.g.)
Infer	to conclude from evidence or premises
Igneous	relating to, resulting from, or suggestive of the intrusion or extrusion of magma or volcanic activity; rock formed from molten magma
Inorganic	involving neither organic life nor the products of organic life of or relating to compounds not containing carbon
Interdependence	state of organisms depending on each other and the environment for survival
Interpretation	explanation – explain the meaning of
Interrelationships	interactions between two or more objects or organisms
Invertebrate	animal, such as an insect or mollusk that lacks a backbone or spinal column
Investigation	inquiry, research, or systematic examination

Involuntary	not under the influence or control of the will; not voluntary; as, the involuntary movements of the body (involuntary muscle fibers)
isotope	any of two or more species of atoms of a chemical element with the same atomic number and nearly identical chemical behavior, but with differing atomic mass and mass number and different physical properties
Justify	to demonstrate or prove to be just, right, or valid
Law	statement that summarizes, identifies, or describes a relationship among observable phenomena
Lever	simple machine consisting of a rigid bar pivoted on a fixed point and used to transmit force, as in raising or moving a weight at one end by pushing down on the other
Limiting factor	conditions or resources that control the size of a population
Liquid	state of matter that does not hold a definite shape but occupies a definite volume because its molecules are in close contact
Lithosphere	outer part of the Earth, consisting of the crust and upper mantle, approximately 100 km (62 mi.) thick
Living	state of being alive
Lunar	of, involving, caused by, or affecting the Moon lunar phase
Macroscopic	large enough to be perceived or examined by the unaided eye; large compared to a microscopic object
Mass	property of a body that is a measure of its inertia and causes it to have weight in a gravitational field that is commonly taken as a measure of the amount of material it contains
Matter	anything that possesses mass and occupies volume
Mean	average value of a set of number
Measure	to ascertain the dimensions, quantity, or capacity of
Meiosis	type of cell division that occurs during the reproduction of diploid organisms to produce the gametes. The double set of genes and chromosomes of the normal diploid cells is reduced during meiosis to a single haploid set in the gametes. Crossing-over and, therefore, recombination occur during a phase of meiosis
Metamorphic	change in the constitution of rock; specifically, a pronounced change affected by pressure, heat and water that results in a more compact and more highly crystalline condition; a rock produced by these processes
meteor	bright trail or streak that appears in the sky when a meteoroid is heated to incandescence by friction with the Earth's atmosphere; also called falling star, meteor burst, shooting star
Microscopic	too small to be seen by the unaided eye but large enough to be studied under a microscope; small compared to a macroscopic object

Mimicry	resemblance of one organism to another or to an object in its surroundings for concealment and protection from predators
Mitosis	cell division; cell division in multicellular organisms occurs by mitosis except for the special division called meiosis that generates the gametes
Mixture	portion of matter consisting of two or more components in varying proportions that retain their own properties
Model	schematic description or representation of a system, theory, or phenomenon that accounts for at least some of its known or inferred properties and may be used for further study of its characteristics
Molecule	smallest particle of a chemical substance that retains all the properties of the substance and is composed of one or more atoms
Mutation	change of the DNA sequence within a gene or chromosome of an organism
Mutualism	close, prolonged association between organisms of two different species in which each member benefits; type of symbiotic relationship natural resource
Natural selection	process by which, in a given environment, individuals having characteristics that aid survival will produce more offspring, so the proportion of individuals having such characteristics will increase with each succeeding generation. Two mechanisms of natural selection include: gradualism - slow genetic modification (evolution) of a population over long periods of time punctuated equilibrium - relatively rapid evolution at a speciation event
Neutron	uncharged elementary particle that has a mass a little greater than that of the proton and is present in most atomic nuclei
Nonliving	objects that don't reproduce, grow, react, or use food
Nonstandard units of measure	Units of measurement based on everyday items (e.g., hands, feet, pace, candy, potato, paper clip) used as a precursor to learning and using standard units of measurement
Mitochondria	are the structures within cells that produce energy.
Mutualism	close, prolonged association between organisms of two different species in which each member benefits
Nucleus	*Physical science*: central region of an atom, which contains more than 99% of the atom's mass. *Life science*: cellular organelle in eukaryotes that contains most of the genetic material
Observe	to be or become aware of, through one's senses, and may include qualitative or quantitative data
Observation	event that is experienced personally or enhanced through measurement or instruments
Opaque	not capable of having light pass through or hard to understand.
Openness	mindset that allows a person to consider explanations of a phenomena

Organic	of, relating to, or derived from living organisms Chemistry: having to do with carbon compounds
organism	living individual, such as a plant, animal, bacterium, protist, or fungus; a body made up of organs organelles, or other parts that work together to carry on the various processes of life
Periodic table	arrangement of the chemical elements by atomic number, starting with hydrogen in the upper left-hand corner and continuing in ascending order from left to right, arranged in columns according to similar chemical properties
PH	numerical measure of the acidity or alkalinity of a chemical solution; the negative of the logarithm of the hydrogen ion concentration
Phenotype	physical or visible characteristics of an organism that are determined by its genotype
photosynthesis	chemical process by which chlorophyll-containing plants use light to convert carbon dioxide and water into carbohydrates, releasing oxygen as a byproduct
Pitch	aurally perceived property of a sound, especially a musical tone that is determined by the frequency of the waves producing it; highness or lowness of sound
Plane	flat or level surface
plate tectonics	theory that explains the global distribution of geological phenomena such as seismicity, volcanism, continental drift, and mountain building in terms of the formation, destruction, movement, and interaction of the Earth's lithospheric plates; the theory that the earth's crust is broken into fragments (plates) which move in relation to one another, shifting continents, forming new crust, and causing volcanic eruptions
Population	group of organisms of the same species living and reproducing in a particular habitat or geographic region
Population density	number of organisms per unit area
Precipitation	any form of water, such as rain, snow, sleet, or hail, which falls to the Earth's surface
Predict	to forecast a future occurrence based on past observations or the extension of an idea
Prediction	statement of an expected (future) outcome of a planned test assuming that the hypothesis being tested is correct; to be compared with observed result to test the hypothesis
Preservation	to keep in perfect or unaltered condition; maintain unchanged
Probability	measure of the likelihood of an event occurring
Procedures	series of steps taken to accomplish an end
Prokaryotic	referring to a cell with no nucleus (e.g., a bacterium)
Property	characteristic attribute possessed by all members of a class
Propose	to put forward for consideration, discussion, or adoption

Proton	stable subatomic particle occurring in all atomic nuclei, with a positive electric charge equal in magnitude to that of an electron
Pulley	simple machine consisting of a wheel with a grooved rim in which a pulled rope or chain can run to change the direction of the pull and thereby lift a load
Pure science	science for the pursuit of scientific knowledge
Qualitative	involving quality or kind
Quantitative	involving the measurement of quantity or amount
Question	to ask
Radiation	transfer of energy by electromagnetic radiation; process of emitting energy in the form of waves or particles (e.g., visible light, X-rays, alpha and beta radiation).the geographic spreading of a species reaction
Recessive	of, relating to, or designating an allele that does not produce a characteristic effect when present with a dominant allele
Reduce, reuse, recycle	help you, your community, and the environment by saving money, energy, and natural resources. Recycling programs are managed at the state and local level
Reflect	to throw or bend back (light, for example) from a surface
Refract	to deflect from a straight path undergone by light or other wave in passing obliquely from one medium (e.g., air) into another (e.g., glass) in which its speed is different
Reliability	to yield the same or compatible results in different clinical experiments or statistical trials
Respiration	physical and chemical processes by which an organism supplies its cells and tissues with the oxygen needed for metabolism and relieves them of the carbon dioxide formed in energy-producing reactions
Result	quantity or expression obtained by calculation
Revolution	orbital motion about a point, especially as distinguished from axial rotation
RNA	(Ribonucleic acid) nucleic acids that contains ribose and uracil as structural components and is associated with the control of cellular chemical activities
Rotation	act or process of turning around a center or an axis; the turning of a body part about its long axis as if on a pivot
Sedimentary	of or relating to rocks formed by the deposition of sediment
Sedimentation	The act or process of depositing or forming a sediment.
Sexual	relating to, produced by, or involving reproduction characterized by the union of male and female gametes
Simple investigation	investigation involving a single variable

Solid	body of definite shape and volume; not liquid or gaseous
Solute	the dissolved matter in a solution; the compound of a solution that changes its state
Solution	a homogeneous mixture of two or more substances
Solvent	a liquid substance capable of dissolving other substances
Species	class of individuals or objects grouped by virtue of their common attributes and their ability to mate and produce fertile offspring, and assigned a common name; a division subordinate to a genus
Spectrophotometer	instrument used to determine the intensity of various wavelengths in a spectrum of light
Stimulus	object or event that causes a response
Strata	a section, level, or division, as of the atmosphere or ocean, regarded as like a stratum
Stratus	low-altitude cloud formation consisting of a horizontal layer of clouds
Structures	way in which parts are arranged or put together to form a whole; makeup arrangement or formation of the tissues, organs, or other parts of an organism; an organ or other part of an organism
Substrate	the substance that is acted upon by an enzyme or ferment; a surface on which an organism grow or is attached
Subsystem	component of a system (e.g., a solar system is a subsystem of a galaxy)
Symbiotic relationship	close, prolonged association between organisms of two different species that may, but does not necessarily, benefit each member; includes mutualism, commensalisms, and parasitism Synthetic
System	1. Group of body organs that together perform one or more vital functions 2. Organized group of devices, parts or factors that together perform a function or drive a process (e.g., weather system, mechanical system)
Technology	application of science, especially to industrial or commercial objectives; tools and techniques
Temperature	degree of hotness or coldness of a body or environment
Theory	collection of statements (conditions, components, claims, postulates, propositions) that when taken together attempt to explain a broad class of related phenomena; inferred explanations for observable phenomena
Tissues	A large mass of similar cells that make up a part of an organism and perform a specific function.
Transient	not regular or permanent
Transparent	something clear, see through or obvious.
Translucent	allowing light to pass through but not showing the distinct images on the other side.

Tsunami	large sea wave caused by an earthquake, landslide or other disturbance under the ocean.
U.S. customary units	measuring system used most often in the United States (e.g., inches, pounds, gallons)
Valid	correctly inferred or deduced from a premise
Variable	A factor or condition that is subject to change, especially one that is allowed to change in a scientific experiment to test a hypothesis.
Vibrate	To shake or move with or as if with a slight quivering or trembling motion