Excellence in Science:
Consensus Curriculum:
Instructional Framework

CATHOLIC SCHOOLS

DIOCESE of RICHMOND

July 1, 2022

Mission Statement

The mission of the Office of Catholic Schools is to assist the Bishop in his mandate as Teacher of the Catholic Faith, by establishing a climate and framework for fostering excellence in catechetical and academic education in the schools of the diocese in adherence to the Magisterium of the Church.

The mission of the schools in the Catholic Diocese of Richmond is to develop and nurture the spiritual, intellectual, social, and emotional growth of each student in the spirit of the Gospels and the teachings of the Catholic Church.

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Contents

Introduction

Through its mission, the Office of Catholic Schools in the Diocese of Richmond is called to establish a climate and framework for fostering excellence in its schools. Aligning to this mission, the Office of Catholic Schools has developed this document, Consensus Curriculum: Instructional Framework for Excellence in Science.

"Catechesis aims to bring about in the believer an ever more mature faith in Jesus Christ, a deeper knowledge and love of his person and message, and a firm commitment to follow him." (*National Directory of Catechesis*, No. 19)

The Consensus Curriculum Instructional Framework serves as the structure for science instruction in all Catholic schools in the Diocese of Richmond. This document identifies the standards and benchmarks that comprise the Science program and articulates what students should know and be able to do. Additionally, it guides and supports teachers in delivering high-quality, effective instruction. The purpose is to assist all students as they mature into skilled learners while they grow their understanding of the Roman Catholic faith and deepen their relationship with Jesus Christ.

The revision process included educators from across the Diocese and representing all grade-level bands. In developing the standards, the committee reviewed the existing Consensus Curriculum standards, along with the standards from various other dioceses including the Diocese of Arlington and the Diocese of Raleigh, as well as the Virginia Department of Education (2017) Science Standards of Learning Curriculum Framework. This document represents a compilation of information gleaned from these sources.

This well-designed curriculum not only imparts knowledge but also equips students with essential skills that they will use throughout their lives. Among these skills are critical thinking, reasoning, problem-solving, and study skills. Critical thinking involves evaluation arguments and evident to make informed decisions. Reasoning is the process of using logic to reach conclusions. Problem-solving is the ability to identify, analyze, and solve problems effectively. Study skills refer to the techniques that students use to manage their time, organize information, and retain what they learn. By incorporating these skills into the curriculum, students in the Diocese of Richmond learn how to approach challenges systematically, think creatively, and become independent learners who are capable of adapting to a changing world.

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 rationale and moral decisions based upon scientific principles and their Catholic Christian values. The skills and knowledge students use to make these types of decisions should reflect their appropriate level of intellectual and emotional growth. This curriculum is designed to stimulate curiosity and to develop morally responsible, scientifically literate citizens. This curriculum stresses the process of science as a way of learning and further emphasizes that scientific knowledge is always subject to change based upon new discoveries and additional knowledge.

Science Teachers as Moral Educators

Pritchard (2006) beautifully articulated the role of science teachers as moral educators when he stated:

> The introduction of ethics in science classes is not the only way to portray science as receptive to open-mindedness and critical questioning. But it is an effective way, and it places science squarely 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 whenever the study of science begins.
>
> Although ethical questions cannot be answered by science alone (there is this much to the fact/value distinction), it seems clear that a reasonable approach to an ethical question requires carefully attending to, and seeking out, all the relevant facts.
>
> Screening out information that may make it more difficult to support one's favored position is contrary to reasonable ethical reflection; and it is contrary to good scientific reasoning. The scientific caution against generalizing from an unrepresentative sampling can help explain the shortcomings of stereotyping (common in racist and sexist thinking, e.g.). The scientific importance of looking at things from as many relevant perspectives as possible can help students understand and resist egocentric thinking, one of the most formidable barriers to reasonableness in social relationships. And the power of analogical reasoning in science can enhance ethical reasoning as well...

Of course, school science programs need to take carefully into account the readiness students have for particular science content and any related ethical issues. At present, there is very little material explicitly designed to assist teachers who wish to integrate ethics into their science teaching. Although there is a growing literature on moral education at these levels, very little addresses the science curriculum. However, the December 1995 report of the Committee on National Standards for Science Education targets objectives that refer to aspects of scientific practice and uses of science that clearly suggest the need to integrate ethics and values issues in science classes. For example, concern the ways in which scientists are expected to: conduct research—sorting out evidence, testing hypotheses, making reliable inferences, accurately reporting data, working cooperatively with others, and the like. The report also includes suggestions for units on personal and social perspectives on science and on the nature of science and science inquiry. Just how any of these objectives might best be met in various levels of the school curriculum needs to be worked out with considerable care; but recent statements of science education goals and objectives at both the state and national level suggest that this task should be undertaken.

Pritchard, M. (2006) "Reasonable Children: Science Teachers as Moral Educators" Online Ethics Center for Engineering 6/21/2006 National Academy of Engineering Accessed: Friday, September 20, 2013

www.onlineethics.org/Education/precollege/childrenreason.aspx

Goals

Through the use of this curriculum, all students will:

1. Develop an understanding of the processes and skills necessary for scientific investigation, problem solving, and critical thinking.
2. Develop responsible Catholic Christian decision-making skills in matters related to science, engineering, and technology's impact on society with respect for the environment and living things.
3. Recognize that science is an integrated study that involves oral and written communication, mathematics, and technology, and is influenced by religious beliefs.
4. Develop an interest, a sense of wonder, and curiosity about the study of the universe while recognizing the objective nature of science with respect to God as Creator.
5. Recognize that science searches for natural explanations of observed phenomena while supernatural explanations are outside the purview of science.
6. Develop an understanding of the scientific process and understand the structure of science, which includes organizing data into facts, principles, models, laws, theories, and hypotheses.

Structure of the Framework

To guide the organization of the Consensus Curriculum, the Diocese of Richmond categorizes the Science essential skills and understandings into four domains. These domains provide the focus of instruction. The domains are:

Scientific Investigation: Scientific investigation is the systematic and structured approach used to explore and understand the natural world through empirical evidence and rigorous methodology. It involves formulating hypotheses, designing experiments, collecting, and analyzing data, and drawing conclusions based on objective observations and logical reasoning. The primary goal of scientific investigation is to advance knowledge, uncover new insights, and contribute to the ever-expanding body of scientific understanding.

Physical Science: Physical science is the branch of science that focuses on the study of non-living matter and energy in the universe. It encompasses disciplines such as physics, chemistry, and astronomy, examining the fundamental principles that govern the natural world. Through experimentation, observation, and mathematical modeling, physical scientists seek to understand the laws and processes that shape our physical reality.

Earth & Space Science: Earth and Space Science is the multidisciplinary field that explores the physical processes and phenomena occurring on Earth and in the vast expanse of space. It encompasses the study of geology, meteorology, oceanography, astronomy, and planetary science to understand Earth's dynamic systems and the universe beyond. By investigating topics such as climate change, celestial objects, plate tectonics, and the origins of the universe, Earth and Space Science provides valuable insights into the interconnectedness and wonders of our planet and the cosmos.

Life Science: Life Science is the branch of science that encompasses the study of living organisms, their characteristics, and their interactions with the environment. It focuses on various sub-disciplines such as biology, ecology, genetics, and physiology, among others, to understand the fundamental principles of life. Life Science plays a crucial role in advancing our knowledge of biological systems and is instrumental in developing solutions for healthcare, agriculture, and environmental conservation.

The Diocesan Science Instructional Framework is rooted in these four fundamental domains. These domains repeat throughout the grades with increasing levels of cognitive demand.

The **Scope and Sequence** document provides a longitudinal view of the instructional standards within each domain across the grades.

Grade specific matter follows. The format for each grade begins with the **Domain**, followed by a **Standard**, which offers the teacher guidance in the key concept to be covered. Each of the standards is then delineated into three components:

> **Benchmarks**, which are the core content and specific knowledge students will know or be able to articulate at their grade level. They are minimum competencies that are measurable.
>
> **Essential Knowledge,** or the key facts, concepts, and ideas needed to successfully meet benchmarks. These provide more detail about the teaching and learning of the benchmarks.
>
> **Essential Questions,** or the overarching or topical questions that guide the lessons; these questions promote conceptual thinking and add coherence to instruction. They are not intended to be assessment questions, rather thinking questions.

It is important to recognize that certain elements of our instruction are revisited in greater depth at each grade level. Students receive spiraling instruction which develops skills in critical thinking, problem-solving, and study habits.

Finally, instructional **Resources/Experiences**, sample **Pacing Guides,** and **Instructional Outlines** are provided electronically in the evolving Curriculum Corner to assist teachers in long- and short-term planning.

Scope and Sequence

The student will:

	Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade
Scientific Investigation 	• demonstrate and understanding of scientific reasoning by planning and conducting investigations in which they observe and classify. • investigate human senses and use their five senses to observe, react, learn, and describe.	• demonstrate and understanding of the world around them by conducting investigations.	• conduct investigations to understand the world around them.	• understand the scientific method and use magnification tools.	• demonstrate an understanding of scientific and engineering practices.	• learn about scientific and engineering practices.
Physical Science 	• investigate and understand that objects (matter) have physical properties that can be described. • investigate and understand foundational concepts of force and motion.	• investigate and understand that objects (matter) have physical properties that can be described. • understand objects move in different ways.	• investigate and understand that matter exists in different phases. • investigate and understand different types of forces may cause an object's motion to change.	• learn about physical properties. • learn about force, motion, and energy. • understand and use simple machines.	• learn about matter and energy.	• learn about matter and its interactions. • learn about light and sound.
Earth and Space Science 	• investigate and understand simple repeating patterns in daily life.	• investigate and understand the relations between the sun and moon. • investigate and understand there are weather and seasonal changes.	• understand forces that change the Earth's surface.	• understand Earth's place in the Solar System. • learn about Earth's systems.	• understand Earth's place in the Solar System. • learn about Earth's landforms and processes that shape the Earth. • learn about weather conditions.	• understand the various systems of Earth. • learn the structure of the Earth and its components. • learn about the patterns, cycles, and changes in the Earth.
Life Science 	• investigate and understand the differences between living organisms and nonliving objects. • investigate and understand basic needs and life processes of plants and animals.	• investigate and understand animals, including humans, have basic needs that allow them to survive. • understand plants have basic life needs and functional parts that allow them to survive	• learn how animals interact with their surroundings and with other animals.	• learn about the interrelationships in ecosystems: plants, animals, and their environment.	• understand the structures of plants and animals. • understand plant and animal ecosystems.	• understand basic cell structure and learn about scientific classification.

6th Grade Life Science	7th Grade Physical Science	High School Earth Science	High School Biology	High School Chemistry	High School Physics
• learn about scientific and engineering practices. • apply computation skills to data analysis and interpretation. • understand all living things are composed of one or more cells that support life processes. • investigate and understand there are levels of structural organization in living things. • investigate and understand organisms reproduce and transmit genetic information to new generations. • investigate and understand there are chemical processes of energy transfer which are important for life. • learn the important role plants play in maintaining life. • investigate and understand that biotic and abiotic factors affect an ecosystem. • investigate and understand how populations in a biological community interact and are interdependent. • investigate and understand how adaptations support an organism's survival in an ecosystem. • investigate and understand ecosystems, communities, populations, and organisms are dynamic and change over time. • investigate and understand relationships between ecosystems dynamics and human activity.	• learn about scientific and engineering practices. • apply computation skills to data analysis and interpretation. • understand all living things are composed of one or more cells that support life processes. • investigate and understand there are levels of structural organization in living things. • investigate and understand organisms reproduce and transmit genetic information to new generations. • investigate and understand there are chemical processes of energy transfer which are important for life. • learn the important role plants play in maintaining life. • investigate and understand that biotic and abiotic factors affect an ecosystem. • investigate and understand how populations in a biological community interact and are interdependent. • investigate and understand how adaptations support an organism's survival in an ecosystem. • investigate and understand ecosystems, communities, populations, and organisms are dynamic and change over time. • investigate and understand relationships between ecosystems dynamics and human activity.	• understand the impact of science on human activities with respect to Catholic morality and beliefs. • incorporate the practices of science and engineering into the study of Earth Science. • demonstrate an understanding of scientific reasoning, logic, and the nature of science. • investigate and understand that Earth is unique in our solar system. • understand the Earth's place in the universe in relationship to the sun and moon. • investigate and understand that many aspects of the history and evolution of Earth and life can be inferred by studying rocks and fossils. • understand the earth's structure and understand the geological processes that take place on the planet. • investigate and understand that there are major rock-forming and ore minerals. • investigate and understand igneous, metamorphic, and sedimentary rocks. • understand and appreciate the role of water on the Earth. • investigate and understand that Earth's weather and climate are the result of the interaction of the sun's energy with the atmosphere, oceans, and land. • understand the relationship between Earth and human activity.	• understand the impact of science on human activities with respect to Catholic morality and beliefs. • incorporate the practices of science and engineering into the study of Biology. • demonstrate an understanding of scientific reasoning, logic, and the nature of science. • investigate and understand the chemical and biochemical principles essential for life. • investigate and understand the relationship between cell structure and cell function. • investigate and understand common mechanisms of DNA function, protein synthesis, and inheritance. • investigate and understand the basis of modern classification methods. • investigate and understand how populations change through time. • investigate and understand dynamic equilibria between populations, communities, and ecosystems.	• understand the impact of science on human activities with respect to Catholic morality and beliefs. • incorporate the practices of science and engineering into the study of Chemistry. • demonstrate an understanding of scientific reasoning, logic, and the nature of science. • investigate and understand how atomic structure determines the placement of elements on the periodic table. • investigate and understand the matter and energy are conserved in chemical reactions. • investigate and understand common molar relationships. • investigate and understand solutions behave in predictable and quantifiable ways. • investigate and understand phases of matter as described by kinetic molecular theory. • investigate and understand basic chemical properties related to organic chemistry and biochemistry.	• understand the impact of science on human activities with respect to Catholic morality and beliefs. • incorporate the practices of science and engineering into the study of Chemistry. • demonstrate an understanding of scientific reasoning, logic, and the nature of science. • investigate and understand displacement, velocity, and acceleration. • investigate and understand a force can change an object's position, velocity, and acceleration. • investigate and understand Newton's Laws of Motion. • investigate and understand circular motion and universal gravitation. • investigate and understand energy and work. • investigate and understand momentum.

Kindergarten

The student will:

Scientific Investigation

- demonstrate and understanding of scientific reasoning by planning and conducting investigations in which they observe and classify.
- investigate human senses and use their five senses to observe, react, learn, and describe.

Physical Science

- investigate and understand that objects (matter) have physical properties that can be described.
- investigate and understand foundational concepts of force and motion.

Earth and Space Science

- investigate and understand simple repeating patterns in daily life.

Life Science

- investigate and understand the differences between living organisms and nonliving objects.
- investigate and understand basic needs and life processes of plants and animals.

Standard K.1 **Scientific Investigation**

The student will demonstrate an understanding of scientific reasoning by planning and conducting investigations. in which they will observe and classify.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize basic properties of objects are identified by direct observation. b. Make observations from multiple positions to achieve different perspectives. c. Sequence a set of objects according to size. d. Separate a set of objects into two groups based on a single physical attribute. e. Use nonstandard units to measure (length, mass, and volume common objects) f. Construct picture graphs using real-life models with nonstandard units. g. Make inferences. h. Recognize a question and predictions are made from one or more observations. i. Record observations. j. Describe objects both pictorially and verbally. k. Recognize unusual or unexpected results in an activity.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: • use senses to understand the natural world. • discuss that objects can be described/classified by color, shape, texture, size, etc. They can look different depending on how you look at them. • recognize science involves asking questions and observing. Observations must be made carefully. • recognize science can be done through simple through hands on, authentic experiences. • explain that patterns can be observed over time and help make predictions about what will happen in the future. • understand conclusions can be made based off of information present. • use nonstandard units to compare objects, even if it is not an exact measurement. • recognize observations can be described orally, pictorially, and in written form.	• How can I use my senses to make observations about my world? • How can I learn about why things happen based off of what I see? • How can I collaborate with other people? • How can I describe and classify objects? • How can I measure or compare objects?

Standard K.2 **Scientific Investigation**

The student will investigate human senses and use their five senses to observe, react, learn, and describe.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Observe and explore surroundings and the world using the senses. b. Describe objects, shapes, animals, people, food, using descriptive adjectives that match the senses used.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. Observe and explore surroundings and the world using the senses. o match five senses with five body parts (nose with smell, etc.) b. Describe objects, shapes, animals, people, food, using descriptive adjectives that match the senses used. o use sensory adjectives to describe objects, plants, and animals, which are seen, heard, smelled, etc.	• What are sensory words to describe our world? • What are our five senses? • What are the five body parts that match with our senses?

Standard K.3 **Physical Science**

The student will investigate and understand that objects (matter) have physical properties that can be described.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize all objects are made of "matter." b. Recognize matter (objects) can be described by their physical properties. c. Recognize water can be described as a solid, liquid, or gas and has its own unique properties. d. Recognize water is essential to our daily lives.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. recognize all objects are made of "matter." b. recognize matter (objects) can be described by their physical properties. o know physical properties include colors, shapes and forms, textures and fell, relative size and w=eight, and position and speed. o describe and compare matter using color, texture, hardness, shapes. o describe and compare matter using weight and relative size. o use rulers and scales to compare actual weights and sizes of objects. o describe and compare relative speeds of objects (fast, slow, quick, etc. o use the scientific vocabulary of the metric system scales when measuring. i. meter = length ii. gram = weight iii. liter = volume c. recognize water can be described as a solid, liquid, or gas and has its own unique properties. d. recognize water is essential to our daily lives. o describe water using terms, "solid," "liquid," and, "gas." o describe how gravity impacts the flow of water downhill	o How do we compare objects? o What are the states of matter? o What are the tools used to measure matter? o Why does water flow downhill? o How does gravity impact items? o What would our lives be without water?

Standard K.4 **Physical Science**

The student will investigate and understand foundational concepts of force and motion.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate how pushes and pulls impact the way an object moves. b. Investigate how objects that move can be stopped or changed by another force.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. Investigate how pushes and pulls impact the way an object moves. o explain how pushes and pulls are opposites and identify examples of each in their world. o compare the movement of two different objects. b. Investigate how objects that move can be stopped or changed by another force. o determine and create examples demonstrating the movement of an object can change if a force or another object acts on it or gets in its way. o investigate magnetism and the impact of magnets on each other	• What are some examples of opposites? • What are examples of pushes and pulls? • How do objects move differently? • How can we stop an object from moving?

Standard K.5 **Earth and Space Science**

The student will investigate and identify simple repeating patterns in daily life.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Observe patterns in daily life, both from a personal perspective and from a nature perspective. b. Observe Earth patterns about temperature, seasons, sunlight throughout the day. c. Recognize patterns as repetitive, so predictions can be made based on current and past conditions. d. Investigate changes that occur over time. e. Recognize God, the Father, as the creator of the Earth.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. observe patterns in daily life, both from a personal perspective and from a nature perspective b. observe Earth patterns about temperature, seasons, sunlight throughout the day. o describe the difference in sunlight during key points in their daily life (waking up, getting to school, coming home, going to bed) o observe differences in temperature during key points in their daily life. o describe patterns in weather throughout the seasons. o investigate shadows, both those found in nature and those manufactured, as created when light is blocked. c. recognize patterns as repetitive, so predictions can be made based on current and past conditions. o observed and measured patterns. d. investigate changes that occur over time. o understand changes can occur fast or slow. e. recognize God, the Father, as the creator of the earth o recognize that God made the Earth and all living things on it. o recognize that God is a part of everything in our world.	• What is the difference in weather during each season? • How is the temperature different when you first wake up versus other key points in your day? • What tools can you use to measure temperature or observe changes in weather patterns? • How can we use current weather patterns to predict the weather? • What are some fast changes that happen in our surroundings (a building being demolished, switching to a different activity in our schedule, the shape of the moon changing) • What are some changes that changes that are slow? (The seasons changing, your height and weight changing from the beginning of the year until the end, waiting for teeth to fall out) • Make observations and gather information about ways people show respect and care for the Earth and all living things.

Standard K.7 **Life Science**

The student will investigate and understand the differences between living organisms and nonliving objects.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the differences between living organisms and nonliving objects. b. Classify items as living or nor nonliving. c. Identify certain characteristics that distinguish living organisms from nonliving objects. d. Identify God as creator of the world.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. Investigate and understand the differences between living organisms and nonliving objects. o identify living and nonliving objects. b. Classify items as living or nor nonliving. c. Identify certain characteristics that distinguish living organisms from nonliving objects. o identify and describe basic characteristics of living organism. These characteristics are growth, movement, response to environment, having offspring, and the need for food, air, and water. d. identify God as the creator of the world. o recognize that all people are made in the image and likeness of God.	• What is an organism? • Organisms have needs and life processes, which distinguish them from nonliving objects. • Some important life processes of living organisms include growth, responding to the environment, and having offspring. • Recognize that each individual is unique and should be treated with love and respect

Standard K.7 **Life Science**

The student will investigate and understand basic needs and life processes of plants and animals.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Compare the basic needs of animals and plants. b. Recognize plants and animals change as they grow, have life cycles, and eventually die. c. Recognize that offspring of plants and animals are similar but not identical to their parents or to one another. d. Identify God as the creator of the world.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. compare the basic needs of animals and plants. o Animals need adequate food, water, shelter, and space; plants need nutrients, water, air, light, and a place to grow. o use observations to describe what plants and animals need to survive. o predict what will happen to animals and plants if life needs are not met. b. recognize plants and animals change as they grow, have life cycles, and eventually die. o describe some simple changes that animals and plants undergo during their life cycle. c. recognize that offspring of plants and animals are similar but not identical to their parents or to one another. o recognize similarities and differences between offspring and parent. d. identify God as the creator of the world	• To survive, plants need water, air, light, and a place that has adequate space for them to grow. • If animals' needs are not met, they move to survive, if they cannot move, they will not survive. If a plant's needs are not met it will not survive. • Simple changes animals undergo during life cycles may include changes in their body size, color, covering, or shape. (Students will not need to know stages/sequences of life cycles) • Simple changes plants undergo during their life cycles may include size, presence of leaves and branches, fruits, and seeds. (Students will not need to know stages/sequences of life cycles) • Many offspring of plants and animals are like their parents but not identical to them or to one another. Other offspring look very different from their parents.

Standard K.8 **Life Science**

The student will investigate and understand their role in caring for God's creation (Earth).

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize materials can be reused, recycled, and conserved. b. Recognize water and energy conservation at home and in school helps ensure resources are available for future use. c. Recognize we are called to care for God's creation.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. recognize materials can be reused, recycled, and conserved. o recognize many materials can be used over and over again and that everyday materials can be recycled. b. recognize water and energy conservation at home and in school helps ensure resources are available for future use. o recognize that energy sources can use renewal or nonrenewal materials. c. Recognize we are called to care for God's creation	•

1st Grade

The student will:

Scientific Investigation

- demonstrate and understanding of the world around them by conducting investigations.

Physical Science

- investigate and understand that objects (matter) have physical properties that can be described.
- understand objects move in different ways.

Earth and Space Science

- investigate and understand the relations between the sun and moon.
- investigate and understand there are weather and seasonal changes.

Life Science

- investigate and understand animals, including humans, have basic needs that allow them to survive.
- understand plants have basic life needs and functional parts that allow them to survive.

Standard 1.1Scientific Investigation

The student will demonstrate an understanding of the world around them by conducting investigations.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. Ask questions and define problems. b. Plan and complete investigations with teacher guidance. c. Collect, interpret, and analyze a set of data that was collected or given. d. Draw and critique conclusions and explanations from an experiment or a set of data. e. Develop and use models. f. Obtain, evaluate, and communicate information about experiments effectively.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. asking questions and defining problems o ask questions and make predictions based on observations. o identify a simple problem that can be solved through the development of a new tool or improved object. b. planning and conducting investigations o with guidance, conduct investigations to produce data. o identify characteristics and properties of objects by observations. o use tools to measure relative length, weight, volume, and temperature of common objects. c. interpreting, analyzing, and evaluating data. o use and share pictures, drawings, and/or writings of observations. o describe patterns and relationships. o classify and arrange objects based on a single physical characteristic or property. o organize and represent various forms of data using tables, picture graphs, and object graphs. o read and interpret data displayed in tables, picture graphs, and object graphs, using the vocabulary more, less, fewer, greater than, less than, and equal to d. constructing and critiquing conclusions and explanations o make simple conclusions based on data or observations. o recognize unusual or unexpected results.	• How can I make predictions using what I have seen or observed? • What are the attributes that can be used to describe an object? • How can I compare objects? • What information do graphs give me? • What is the appropriate tool to use to measure …..? • How are two objects similar/different?

e. developing and using models o use physical models to demonstrate simple phenomena and natural processes. • obtaining, evaluating, and communicating information o communicate observations and data using simple graphs, pictures, drawings, numbers, speech and/or writing	

Standard 1.2 **Physical Science**

The student will investigate and understand that objects (matter) have physical properties that can be described.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize matter (objects) is made of one or more materials and can be identified and described by their physical properties. b. Recognize different types of matter (objects) interacts with water differently depending on its properties.	
sential Knowledge y facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas

To be successful with this standard, students are expected to:
• classifying objects by physical properties such as color, shape, texture, size, weight
  o use the scientific vocabulary of the metric system scales when measuring.
  ▪ meter and centimeter = length
  ▪ gram and kilogram = weight
  ▪ liter and milliliter = volume
• understand some solids will dissolve in water, but others will not.
• Observe changes when matter is placed in water depending on temperature
	• How do you describe/identify matter?
	• What will happen when you put X in water?
	• What can you observe when X is placed in water?

Standard 1.3 **Physical Science**

The student will understand objects move in different ways.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that there are different types of motion besides push-pull, such as back and forth, circular, and straight. b. Explain how vibrations are created by different materials and how sound is made as a result.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. make and communicate observations about the way objects move. o understand how forces cause an object to move or change its movement. o compare movement between two or more items. b. explain how vibration creates sounds. o communicate observations of an object with rapid back and forth motion (vibrations)	• What are some forces that can be placed on an object to make it move? • What are some examples of back and forth/circular/straight movements? • How can we stop an object from moving? • What are some movements we can make with different parts of our bodies? • How does X move compared to Y? • Where can we observe vibrations creating sound?

Standard 1.4 **Earth and Space Science**

The student will investigate and understand the relationship between the sun and moon.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that shadows are created by the blocking of the sun or artificial light source. b. The sun and moon rise in a predictable pattern. c. The direction of the sun's rays affects the length of a shadow. d. Sunlight varies from season to season affecting temperature and daylight hours versus night.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: ● recognize sun patterns can be used to describe the difference in shadows at various points in the day. ● explain the sun rises in the east and sets in the west. ● explain the moon rises with the sun set. ● describe the sun's path is higher in the sky during the summer and lower during the winter making more daylight in the summer than the winter. ● recognize that God, the Father is the creator of all things	● How can we use shadows to determine where the sun is in the sky? ● What is the pattern of the sun/moon rise and set? ● Why is it cold in the winter and hot in the summer? ● How does the sun's path in the different seasons affect the amount of daylight hours we have?

Standard 1.5 **Earth and Space Science**

The student will investigate and understand there are weather and seasonal changes.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that changes in light, temperature, and precipitation impact humans, animals, and the environment. b. Understand the relationships between day-to-day weather and seasonal changes. c. Changes in weather can be observed over time. d. Know the types of weather. e. Observe seasonal changes in plants.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. understand that changes in light, temperature, and precipitation impact humans, animals, and the environment. o Describe how light, temperature, and precipitation impact our day-to-day activities and how we choose to dress. o describe how light, temperature, and precipitation influences animal behavior, such as thicknesses of fur, and migration/hibernation patterns of animals. b. understand the relationships between day-to-day weather and seasonal changes. c. understand changes in weather can be observed over time. o observe, record, and compare seasonal data throughout the year, including temperature, precipitation, and amount of sunlight. o represent data in tables and graphic displays to describe weather. d. know the types of weather. o identify types of precipitation such as rain, snow, and ice and describe the temperature condition of each. The look of each is different. o identify the daily weather using descriptive terms, such as sunny, cloudy, windy, cold, warm, hot. e. Observe seasonal changes in plants. o Observe the seasons through observation of a plant or tree around school.	• How does the weather help us make choices about what we are wearing or what activities we do? • How does the weather impact animals? • What do animals do in different seasons to survive? • How does the weather impact plant and trees? How do trees look different depending on the season? • What types of weather do we see in each season? • Do some types of weather occur in more than one season? • What are the different types of precipitation (water) that we can experience? • How do plants and trees experience seasons?

○ observe and record seasonal changes in plants such as budding, growth, and losing leaves, recognize the seasons during which these most likely occur. ○ Describe how light, temperature, and precipitation influences plants, trees, and the environment (less rain, dryer soil which impacts the plants. Sun exposure causes color changes of the leaves faster) ○ Colder temperatures are experienced in the winter and influence if it rains or snows in the winter, spring is rainier to help plants grow, etc. f. Recognize that God, the Father is the creator of all things	

Standard 1.6 **Life Science**

The student will investigate and understand animals, including humans, have basic life needs that allow them to survive.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize all animals, including humans, have basic life needs to live, including food, water, air, and shelter. b. Recognize animals have different physical traits/characteristics that perform certain jobs/functions. c. Recognize animals can be grouped/categorized based on multiple, various characteristics. d. Recognize humans are created in God's image in their moral, spiritual, and intellectual nature	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. recognize all animals, including humans, have basic life needs to live. o Animals, including humans, have these basic needs to live food, water, air, and shelter. o Energy and matter are needed for all living organisms to survive. b. recognize animals have different physical traits/characteristics that perform certain jobs/functions. o Animals, including humans, have various physical characteristics that help them live in their environment. These include: ▪ appendages, such as arms, legs, wings, fins, and tails, which protrude from the body and have certain functions. ▪ body coverings, which include hair, fur, feathers, scales, and shells. o Physical characteristics can also determine where an animal can live. ▪ land or water (fur and legs that allows bears to live on land or scales and fins that allow fish to live in water) ▪ their form of movement, which may include walking, crawling, swimming, or flying. c. recognize animals can be grouped/categorized based on multiple, various characteristics. o recognize humans are created in God's image in their moral, spiritual, and intellectual nature	How do we know something is alive? Could we use this knowledge to sort living vs. nonliving things in our environment? How does the type and amount of food differ for animals based on habitat and seasons? How does the amount and source of water differ for animals based on habitat and seasons? What type of home (land or water) would an animal live in based on its physical characteristics? What group of animals (mammals, fish, birds, reptiles, or amphibians) does an animal belong based on its characteristics? Explain the grouping.

Standard 1.7 **Life Science**

The student will understand plants have basic life needs and functional parts that allow them to survive.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that plants have basic needs to survive. b. Identify the basic parts of plants. c. Explore how plants can be classified based on a variety of characteristics. d. Recognize God, the Father, is the creator of all things.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. understand that plants have basic needs to survive. o plants have basic needs that include nutrients, air, water, light, and a place to grow. b. identify the basic parts of plants. o The functions of various plant parts include: the roots which hold plants in place and absorb water, seeds which make new plants, leaves which make food for the plant, and stems which hold the plants upright and transport materials up and down the plant. o Plants have different parts that serve different functions in growth, survival, and reproduction. c. Explore how plants can be classified based on a variety of characteristics. o Plants can be categorized by their different characteristics (edible/nonedible, flowering/nonflowering, and evergreen/deciduous.) d. Recognize that God, the Father is the creator of all things. o God created order out of chaos; the study of science helps us understand God's order.	What does a plant need to survive? What would happen if a plant did not have one or more of its basic needs? What are the parts of a plant? What is the function of each part? How do the various parts contribute to growth, survival, and reproduction of the plant? How are various plants different from one another? Can they be categorized?

2nd Grade

The student will:

Scientific Investigation

- conduct investigations to understand the world around them.

Physical Science

- investigate and understand that matter exists in different phases.
- investigate and understand different types of forces may cause an object's motion to change.

Earth and Space Science

- understand forces that change the Earth's surface.

Life Science

- learn how animals interact with their surroundings and with other animals.
- investigate and understand plants and animals undergo a series of orderly changes as they grow and develop.

Standard 2.1 **Scientific Investigation**

The student will conduct investigations to understand the world around them.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. Demonstrate understanding of scientific inquiry by asking questions and defining problems. b. Develop questions based on observations. c. Conduct investigations to produce data. d. Analyze a set of data that was collected. e. Draw conclusions from an experiment or a set of data. f. Develop and use models. g. Evaluate and communicate information about experiments effectively.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: ● Ask questions that can be investigated and built upon ● Make predictions based on observations and prior experiences. ● Distinguish between opinion and evidence. ● Use appropriate tools to measure (weight, length, mass, time, etc.) ● Understand variables (environment and human error) that impact an experiment. ● Organize and represent data in graphs using numbered and labeled axis, with headings. ● Identify unexpected results (determine if your hypothesis was right or wrong)	● How do I determine what prior experiences are helpful to my current experiment or learning? What do I know about this subject? ● What tools are appropriate to use to measure…? ● What would I do differently in the next round of my experiment? ● What is the best way to represent my data? ● How can I tell if my experiment was successful? ● Do my experimental results support my hypothesis? ● How do we interpret unexpected results?

Standard 2.2 **Physical Science**

The student will investigate and understand that matter can exist in different phases.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. Understand matter (objects) exist in different phases and can be classified by their physical properties in each phase as well as by volume. b. Recognize water is unique and can exist in all three states of matter. c. Understand heating and cooling changes states of matter. d. Recognize some materials can change states of matter and some cannot.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: a. understand matter (objects) exist in different phases and can be classified by their physical properties in each phase as well as by volume. o solids, liquids, and gases have their own unique properties. o define matter and examples of matter in each state. o classify and compare materials. o liquid volume is constant regardless of the shape of its container. o gasses expand/condense to take full volume of their container. o Recognize water is unique and can exist in all three states of matter. b. Understand heating and cooling changes states of matter. c. Recognize some materials can change states of matter and some cannot	• What are some examples of solids, liquids, and gases? • How do you know X is a solid, liquid, or gas? • When are times in nature where we can observe changes in states of matter? (Snow melting, frost on the grass) • Is a cup of water a cup of water if it is spilled onto a tray? • What will happen if we heat/cool X? • What are some examples of materials in a specific state of matter that cannot be reversed?

Standard 2.3 **Physical Science**

The student will investigate and understand different types of forces that may cause an object's motion to change.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand forces can cause an object to move or cause an object to change its movement. b. Recognize forces can be contact or non-contact, such as gravity. c. Use magnets to experience forces. d. Recognize forces have applications in our lives.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas

To be successful with this standard, students are expected to:
• explain how forces can cause an object to move or cause an object to change its movement.
• demonstrate contact and noncontact forces that cause objects to move.
  • investigate the effect of contact and noncontact magnetic forces on the movement of objects.
  • predict which materials will be attracted to magnets, evaluate the predictions, and create a chart that shows the results, classifying materials as to whether they are attracted to magnets.
  • investigate relationships of gravitational or magnetic interactions between two objects that are not in contact with each other.
• identify examples of the effect of gravity
• describe applications of forces in everyday life
  a. identify a simple problem that can be solved through the development of a new tool or an improved object that uses forces from direct contact or from a distance.
	How can we observe friction in everyday life?
	How can we observe gravity in everyday life?
	Compare/contrast gravity and friction.
	What is the difference between a contact/non-contact force?
	What does repel/attract mean? How can we observe this?
	What are some real-life examples of forces and motion around us?

Standard 2.4 **Earth and Space Science**

The student will understand forces that change the Earth's surface.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that some changes in our world happen slowly over thousands of years and others happen more rapidly. b. Understand slow and fast changes impact the formation of the earth (landforms). c. Understand extreme weather impacts the earth and its surroundings. d. Describe the types of precipitation and how they vary from season to season.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: • Understand erosion and weathering cause the land to change over time while volcanic eruptions, earthquakes, and extreme weather (tornado, hurricane, forest fires) causes rapid changes. • understand precipitation can be rain, sleet, hail, or snow and they fall in different seasons and have different physical properties. • Explain how landforms, such as volcanoes, rivers, oceans, lakes, hills, form due to changes in the earth. • Recognize God is the creator of everything.	What causes changes to the earth's surface? What types of extreme weather do we see in the news or our community that causes a change in our earth or immediate environment? Why does it only snow in the winter but not in the summer? Why is sleet a winter weather precipitation, but hail falls in the warm months? How do landforms (volcanoes, rivers, oceans, lakes, hills) get here as a result of slow/fast changes?

Standard 2.5 **Life Science**

The student will learn how animals interact with their surroundings and with other animals.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Explain how living things depend on their environment and other animals for their survival. b. Know the basic needs of all animals. c. Describe how habitats of animals can change over time due to the environment or human factors.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
To be successful with this standard, students are expected to: • Recognize living things as part of various food chains. If there is a break in the chain, animals at the top will not survive. o Food chains and animal interactions are part of a living system. o Animals need food, water, and shelter to survive. The amount each type of animal needs varies. • Recognize shelters can be living things or nonliving things. o Habitats can include oceans, grasslands, forests, rivers, and swamps. Human threats to these habitats pose a risk for the animals that live there. o Humans are a major threat in general to our environment and to animal and plant life. • Recognize animal behaviors changes depending on the season. • Demonstrate an attitude and respect and reverence for one's local and global community.	How do we know something is alive? Could we use this knowledge to sort living versus nonliving things around us? What do animals need to survive? What do plants need to survive? What is the best habitat for _____? What makes this habitat best? How do animals change their behavior depending on the season? ex: why don't we see as many bears in the cold winter months? How are humans affecting the environments of different animals?

Standard 2.6 **Life Science**

The student will investigate and understand plants and animals undergo a series of orderly changes as they grow. and develop.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand the life cycles of plants and animals. b. Identify key changes animals and plants experience at various points of the cycle. c. Recognize the order in which changes take place in plants and animals and that a cycle continues in a predictable way.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas

To be successful with this standard, students are expected to:
• explain how animals and plants change as they grow.
  • analyze a model of the life cycle of an insect and describe the changes that occur within the life cycle.
  • analyze a model of the life cycle of a mammal and describe the changes that occur with the life cycle.
• compare life cycles of an insect and a mammal.
• investigate the question, "What is the life cycle of a flowering plant?" and record observations using a table and/or graph; explain the results of the investigation.
• compare life cycles of a plant and an animal.
• develop models to describe the concept that organisms have unique and diverse life cycles, but they all have in common birth, growth, reproduction, and death.
	• What changes do butterflies, frogs, etc. go through in their lifetime?
	• How does a flower start out?
	• When can we observe animals and plants going through changes?

3rd Grade

The student will:

Scientific Investigation

- understand the scientific method and use magnification tools.

Physical Science

- learn about physical properties.
- learn about force, motion, and energy.
- understand and use simple machines.

Earth and Space Science

- understand Earth's place in the Solar System.
- learn about Earth's systems.

Life Science

- learn about the interrelationships in ecosystems: plants, animals, and their environment.

Standard 3.1Scientific Investigation

The student will understand the scientific method and use magnification tools.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate understanding of scientific inquiry by asking questions and defining problems. b. Develop questions based on observations. c. Conduct investigations to produce data. d. Analyze a set of data that was collected. e. Draw conclusions from an experiment or a set of data. f. Develop and use models. g. Evaluate and communicate information about experiments effectively.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
VOCABULARY: *question, research, hypothesis, experiment, observation, conclusion, presentation, magnifying glass, microscope, telescope* Scientific Method: question, research, hypothesis, experiment, observation, conclusion, presentation A magnifying glass, microscope, and telescope help you see objects more clearly. Use of appropriate tools to measure length, volume, and mass using metric and standard units. St. Albert the Great, Saint Giuseppe Moscati, Saint Abbo of Fleury are examples of scientists in their time.	What are the steps in the Scientific Method? How do you use the Scientific Method when conducting an experiment? What tools are used for investigation and observation? How do you interpret and analyze data? What saints designated their time to a scientific field?

Standard 3.2 **Physical Science**

The student will learn about physical properties.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand that objects are made of materials that can be described by their physical properties.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• **VOCABULARY**: *physical property: solid, liquid, gas, mass, volume* • The 4 states of matter are solid, liquid, gases, and plasma (plasma is discussed in greater detail in later grades). • Objects are made up of more than one material. • Physical properties remain the same even if the material is changed by visible size. • Physical properties include color, texture, temperature, phase, and the ability to dissolve in water. • Mass is the amount of matter in an object. • Volume is the amount of space the object takes up.	• What are the 3 states of matter? • What materials can make up an object (i.e., shoes/furniture/toys) • What is the difference between mass and volume of an object?

Science: 3.3 **Physical Science**

The student will learn about force, motion, and energy.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand what force, motion, and energy are and how they are connected.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• **VOCABULARY**: *force, friction, motion, balance, energy, fossil fuels, nuclear power* • Forces cause a change in motion. • Friction is a force that opposes motion. • Motion is described by distance and time. • An unbalanced force on one side of an object can make it start moving. • Balanced forces pushing on a box from both sides will produce no motion. • Examples of motions with a predictable pattern could include a child swinging in a swing and two children on a teeter-totter. • The sun, water and wind are all sources of energy. • Fossil fuels and nuclear power are sources of energy.	• What are the characteristics of a moving object? • What causes a change in motion? • What is a force that opposes motion? • How is motion described? • What effect does motion have on an object? • What is an example of motion with a predictable pattern? • What are the different sources of energy?

Science: 3.4 **Physical Science**

The student will understand the use of simple machines.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that simple machines are used to make work easier.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• **VOCABULARY**: *inclined plane, lever, wedge, wheel and axle, pulley, screw* • Simple machines are used to make work easier. • The six types of machines are an inclined plane, lever, wedge, wheel and axle, pulley, and screw. • An inclined plane helps move heavy objects from a high place to a low place and vice versa. A wheelchair ramp or a boat ramp are examples of an inclined plane. • A lever can help move heavy weights with less effort. Scissors and teeter-totters are examples of a lever. • A wedge is like a moving inclined plane. Axes and doorsteps are examples of wedges. • A wheel and axle are used to carry objects a long distance. A wheelbarrow and Ferris wheel are examples of wheel and axle. • A pulley helps move things by pulling down rather than pulling up. An example of a pulley is getting water from a well and an elevator. • A screw is a nail with grooves in it. Bottle tops and corkscrews are examples of screws.	• What are 6 types of simple machines? • What is an example of each machine? • What is the function of each machine? • How does this make work easier?

Standard 3.5 **Earth and Space Science**

The student will understand Earth's place in the Solar System.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the characteristics of Earth and the solar system, both are examples of God's creations.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• **VOCABULARY**: *orbit, planet, rotate, revolve, rotation, revolution, axis, moon phases* • The sun is at the center of our Solar System. • The moon revolves around the planet. • All planets orbit the sun. • The sun provides light and heat to maintain the temperature of the Earth. • The moon does not change shape, but at different times appears to change shapes. • Day and night are caused by Earth's rotation on its axis. • The sun-earth-moon relationships cause the seasons and tides.	• What is the position of the sun, moon, planets, and stars in the solar system? • Do all planets orbit the sun? • What provides light and heat necessary to maintain the temperature of the earth? • Why does the moon appear to change to shape throughout the month? • What causes day and night? • What is the relationship of the sun, moon, and Earth regarding the seasons and tides?

Standard 3.6 **Earth and Space Science**

The student will learn about Earth's systems.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate the various structures and processes of the Earth system.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• **VOCABULARY**: *Mineral, igneous rock, metamorphic rock, sedimentary rock, rock, clay, silt, humus, natural resource, conservation, evaporation, precipitation, condensation* • Rocks contain minerals. • Minerals look the same throughout while you can see different minerals within rocks. • Soil provides support and nutrients for plant growth. • Soil is a natural resource that provides support and nutrients necessary for plant growth. • Soil is made up of rock, clay, silt, sand, and humus. • Weathering and erosion are caused by wind and water. • The water cycle involves the process of evaporation, precipitation, and condensation. • Water on Earth is limited and needs to be conserved. • God is the creator of all things, and we are called to care for our Earth.	• What are the differences between igneous, metamorphic, and sedimentary rocks? • What are the components of soil? • What are natural resources and how can they be conserved? • What are the processes of the water cycle? • How can water be conserved? • What happens if we do not take care of our Earth?

Standard 3.7 **Life Science**

The student will learn about the interrelationships in ecosystems: plants, animals, and their environment.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Develop an understanding of the impact of environmental changes; some organisms survive and reproduce, some move to new habitats, some move into a new or transformed environment, and some die.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● **VOCABULARY**: *ecosystem, habitat, population, community, adaptation, producers, consumers, decomposers, herbivores, carnivores, omnivores, fossils* ● Some animals form groups in order to survive. ● Adaptations allow animals to satisfy life needs for survival. ● A food chain shows how living things get food. ● Food chains show how nutrients and energy are passed from different animal life. ● Fossils provide evidence of the life of organisms long ago. ● Fossils can be found in different environments: ○ Marine fossils found on dry land. ○ Tropical plant fossils found in Arctic areas. ○ Fossils of extinct organisms ● In a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. ● When the environment changes, the types of plants and animals that live there can change. ● God is the creator of all things, and we are called to care for our Earth.	● Why do animals form groups in order to survive? ● What adaptations allow animals to satisfy life needs for survival? ● What is the relationship (compare/contrast) among organisms in aquatic and terrestrial food chains? ● Analyze and interpret data from fossils to provide evidence of life as organisms long ago. ● Why do some organisms survive in a particular habitat? ● What environmental changes have an impact on where animals and plants live?

4th Grade

The student will:

Scientific Investigation

- demonstrate an understanding of scientific and engineering practices.

Physical Science

- learn about matter and energy.

Earth and Space Science

- understand Earth's place in the Solar System.
- learn about Earth's landforms and processes that shape the Earth.
- learn about weather conditions.

Life Science

- understand the structures of plants and animals.
- understand plant and animal ecosystems.

Standard 4.1 **Scientific Investigation**

The student will demonstrate an understanding of scientific and engineering practices.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate an understanding of scientific and engineering practices.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
•identify specific and not specific questions. •develop a hypothesis as cause effect relations. •identify variables when planning and investigation. •collaboratively plan and conduct investigations •organize and interpret data in bar and line graphs. •develop and or use models to explain natural phenomena. •identify limitations of models •communicate scientific information, design ideas, and/or solutions with others. •Develop responsible Catholic Christian decision-making skills in matters related to science.	• What are the steps in the scientific method? • What is a hypothesis? • How are variables different from controls in Scientific investigation? • How is data communicated using a bar graph? a line graph? • How can a model demonstrate features in nature? • How is a model limited in representing naturally occurring events? • What are ways to share data, ideas, solutions with others?

Standard 4.2 **Physical Science**

The student will learn about matter and energy.

Benchmarks Key knowledge and skills we want students to know and be able to do.	
a. Describe properties, structure, and changes in matter. b. Examine the different forms of energy and the characteristics of electricity and magnetism.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Describe the three states of matter (solid, liquid, gas) • Examine how changing temperature affects changes in states of matter. • Compare and contrast forms of energy: electrical, mechanical, and chemical. • Identify potential and kinetic energy. • Examine the characteristics of static electricity. • identify basic circuits and properties of current electricity to include the process and purpose of conductors, insulators, and resistors. • Analyze the ability of electrical energy to be transformed into light, motion, and to produce heat. • Compare the relationships between electrical charges (positive and negative) and magnetic poles (north and south). • Examine the amount of force exerted between two objects as related to electricity and magnetism. • Describe how distance and orientation affects force. • Examine motion and the influences of force, mass, and friction. • Explore the relationships, elements, and underlying order of God's creation of the physical world.	• What are the characteristics of each state of matter (particles, shape, volume)? • How does heating and cooling change the different states of a material? • How is each form of energy different (electrical, mechanical, chemical) • How is each form of energy (electrical, mechanical, chemical) used or useful in our daily lives? • Can you demonstrate the differences between potential and kinetic energy? • What is static electricity and how do charges move? • How does current move through conductors, resisters, and insulators? • How are series and parallel circuits formed? • What are the ways that electrical energy is used to produce light, motion, and heat? • How do magnetic poles attract and repel? • What is force? • How does force, mass, and friction impact motion?

Standard 4.3 Earth and Space Science

The student will understand Earth's place in the solar system.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the characteristics of Earth and the Solar System.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Identify the characteristics of the planets. • Investigate and understand the Earth in relationship to the moon, sun, and other planets. • Sequence the eight planets in the Solar System based on their size. • Describe and differentiate between revolution and rotation of the Earth. • Use terminology to describe the phases of the moon. • Describe the sun's characteristics using size, color, and composition. • Provide evidence of a developing appreciation of the relationships, elements, underlying order, and meaning of God's creation.	• How far is each planet from the sun? • What is each planet made of (terrestrial/Jovian, dwarf) • What is the sequence of the planets in the solar system? • What is the size and distance of the sun, planets, and stars? • What is the revolution of Earth and what does it cause? • What is the rotation of Earth and what does it cause? • What are the phases of the moon? (Waxing, waning, full, crescent, new) • How does the tilt of the earth cause our seasons? • What are solar flares and dark spots?

Standard 4.4 **Earth and Space Science**

The student will learn about Earth's landforms and processes that shape the Earth.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand the various processes and changes of Earth's landforms and characteristics, providing a deeper understanding of human activity and Earth's natural resources.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Compare Earth's land features including volcanoes, mountains, valleys, canyons, caverns, and islands. • Compare Earth's salt and freshwater features including oceans, rivers, lakes, ponds, streams, and glaciers. • Examine how rock layers and fossils indicate a change from land to water over time. • Describe how rock layers and fossils give evidence to the changes of Earth's surface over time. • Examine how water, wind, vegetation, and animals can cause weathering and at varying rates. • Identify how erosion occurs at varying rates as impacted by water, ice, wind, and vegetation. • Examine how topographic maps are used to communicate the elevation of landforms. • Describe how natural disasters create damage which requires real world solutions. • Develop an understanding that the use of scientific investigation can be directed toward the preservation and conservation of the creation God has given us.	• What are the characteristics of Earth's landforms? (Volcanoes, mountains, valleys, canyons, caverns, and islands) • How are Earth's water features, salt, and freshwater, alike and different? • How do the rock layers indicate the changes of Earth's surface over time? • How do fossils support and give evidence of the changes in Earth's surface over time? • What are the primary forces that lead to weathering of Earth's surfaces and landmarks? • What elements influence the rate at which weathering occurs? • How do topographic maps show the elevations of Earth's surfaces? • How do natural disasters damage Earth's features and landmarks?

Standard 4.5 **Earth and Space Science**

The student will learn about weather conditions.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand that weather conditions and events occur and can be predicted.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Analyze and report data on temperature and precipitation. • Compare the types of weather associated with high- and low-pressure air masses. • Examine the different cloud types and the weather associated with each. • Explore how different weather instruments are used to gather weather data. • Analyze weather data and use results to make weather predictions. • Examine storm types and the weather conditions associated with each. • Describe the difference between weather and climate. • Explore the elements of weather and who they impact and benefit God's creation.	• How do we measure temperature? • What are the four types of precipitation? • How does a change in temperature affect the type of precipitation? • How are cirrus, stratus, cumulus, and cumulonimbus clouds formed and what are their characteristics? • What types of weather does each type of cloud bring? • What is air pressure and how is it measured? • How do high and low-pressure centers form? • What types of weather are associated with high- and low-pressure centers? • What are the instruments/tools used to measure temperature, air pressure, precipitation, and wind speed? • How are weather conditions/data used to make weather forecasts? • What are the conditions that create extreme weather events like thunderstorms, hurricanes, typhoons, and tornadoes? • How are weather and climate different?

Standard 4.6 Life Science

The student will understand the structures of plants and animals.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Identify the parts of plant and animal cells (cell membrane versus cell wall, chloroplasts, and shape) • Describe the process of photosynthesis. • Identify plant structures (thorns, stems, roots, colored petals, and leaves) • Describe the process of pollination, including the parts of the plant involved in the process (stamen, pistil, sepal, embryo, spore, and seed) • Explain plant dormancy. • Identify animal structures (stomach, lungs, brain, heart, skin) • Show care and concern for all of God's creation, including all stages of life.	• What are the differences between plant and animal cells? • How does photosynthesis occur in plants and what do plants use photosynthesis to make? • What are the parts of a plant and what do they do to help the plant survive? • What is pollination and why is it important for plants? • What is a plant doing during dormancy? • What are the basic animal structures? • What is the role of each animal structure in the major body systems?

Standard 4.7 Life Science

The student will understand plant and animal ecosystems.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate how plants and animals in an ecosystem interact with one another and the nonliving environment.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Describe the behavioral and structural adaptations of plants and animals. • Identify plant and animal communities and how they are organized. • Examine the flow of energy through food webs. • Describe characteristics of habitats and niches. • Compare the life cycles of plants and animals and their impact on the community. • Examine the influence of human activity on ecosystems. • Explain how creation is an outward sign of God's love and goodness.	• How have different types of plants adapted to their environments? • What are body parts or behaviors that have helped animals adapt to their surroundings? • How do plants and animals within communities interact with each other? • How do energy and nutrients flow through food webs? • What is a habitat? • What are niches? • How does the role of a plant or animal in its community change across its lifecycle? • How does human activity impact ecosystems?

5th Grade

The student will:

Scientific Investigation

- learn about scientific and engineering practices.

Physical Science

- learn about matter and its interactions.
- learn about light and sound.

Earth and Space Science

- understand the various systems of Earth.
- learn the structure of the Earth and its components.
- learn about the patterns, cycles, and changes in the Earth.

Life Science

- understand basic cell structure and learn about scientific classification.

Standard 5.1 Scientific Investigation

The student will learn about scientific and engineering practices.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate an understanding of scientific and engineering practices.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *problem, hypothesis, materials, procedure, experiment, results, conclusion, variables* ● asking questions and defining problems ● planning and conducting investigation ● interpreting, analyzing, and evaluating data. ● constructing and critiquing conclusions and explanations ● developing and using models ● obtaining, evaluating, and communicating information ● Develop responsible Catholic Christian decision-making skills in matters related to science.	● What are the steps of the scientific method? ● Is my question testable through an observable and predictable experiment? ● What are the independent and dependent variables in an experimental plan? ● Is my experimental plan an organized plan that will result in data? ● What data needs to be collected to answer a testable question? ● Can you use the data collected to refine your design? ● How can you communicate your experiment, design ideas and solutions with others?

Standard 5.2 **Physical Science**

The student will learn about matter and its interactions.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Extend conceptual understandings of Matter and its interactions with various substances.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *matter, mass, atoms, elements, molecules, compounds, solutions, mixtures, electrons, protons, neutrons, nucleus, States of matter, Celsius, solubility, solute, solvent, electrical conductivity, thermal conductivity, density, reflectivity* ● Describe the characteristics of matter. ● Identify the atomic structure of matter to include electrons, protons, neutrons, and nucleus. ● Examine the states of matter and how temperature impacts the change of state. ● Explore the solubility of substances. ● Describe the physical properties of matter to include color, hardness, reflectivity, electrical conductivity, thermal conductivity, density, and solubility. ● Develop Catholic decision-making skills in matters related to Physical Science.	● What are the characteristics of all matter? ● What is the atomic structure of matter and what are the electrical charges of each part? ● How does temperature change affect the states of matter? ● How do the processes of dissolving and mixing form new substances? Which substance is the solute, and which is the solvent? ● What are the differences between a mixture, solution, and compound? ● What are the observable properties of matter? How do you determine a substance's reflectivity, electrical conductivity, thermal conductivity, density, and solubility? ● What are the common elements found in our environment? How are the elements arranged in the periodic table?

Standard 5.3 **Physical Science**

The student will learn about light and sound.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the concepts of light and sound.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *transverse waves, visible spectrum, opaque, transparent, translucent, prisms, reflection, refraction, compression waves, vibration, wavelength, frequency, amplitude, sound waves* ● Describe how light is a transverse wave. ● Describe the visible spectrum. ● Identify the differences between opaque, transparent, and translucent. ● Demonstrate the reflection of light from a reflective surface and refraction of light through water and prisms. ● Describe a compression wave. ● Examine how sound is transmitted through different media and states of matter. ● Examine the uses and applications of sound waves.	● What is a transverse wave of light? ● What is the visible spectrum of light for humans? ● What are examples of materials that are opaque, transparent, and translucent? ● Why does light reflect on some surfaces and refract in water and prisms? ● What is a compression wave of sound? ● How well does sound travel through different mediums? ● How well does sound travel through different states of matter? ● What occupations use information on sound and sound waves to make decisions and accomplish jobs?

Standard 5.4 **Earth and Space Science**

The student will understand the various systems of Earth.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand how Earth's major systems interact in various ways.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *geosphere, biosphere, hydrosphere, atmosphere, climate, weather, landforms, ecosystems* ● Identify the geosphere, biosphere, hydrosphere, and atmosphere. ● Describe the influence of oceans on ecosystems, landforms, and climate. ● Explain the influence of the atmosphere on landforms and ecosystems through weather and climate. ● Identify the influence of mountain ranges on wind and clouds in the atmosphere. ● Discuss the importance of being good stewards to the environment and all of God's creation.	● What is the geosphere, biosphere, hydrosphere, and atmosphere? ● How do oceans affect weather, climate, landforms, and ecosystems? ● How does the atmosphere affect landforms and ecosystems through weather and climate? ● How do mountain ranges affect wind and clouds in the atmosphere?

Standard 5.5 **Earth and Space Science**

The student will learn the structure of the Earth and its components.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the basic structure of the Earth and the effects of plate tectonics.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *crust, mantle, outer core, inner core, plates, plate tectonics, colliding boundaries, spreading boundaries, sliding boundaries, Ring of Fire, earthquakes, volcanoes, topographical maps* ● Identify the structure of the Earth. ● Explain plate tectonic theory and its relationship to the movement of the Earth's crust. ● Describe how Earth's surface is constantly changing as a result of moving plates. ● Plot locations of volcanoes and earthquakes to illustrate the pattern of geological activity and how this pattern may help predict them. ● Examine topographical maps	● What are the layers of the Earth and where are they located on a model of the Earth? ● What are plates and the theory of plate tectonics? ● What are the 3 types of moving plates and what are the effects of the plates moving? ● Where are earthquakes and volcanoes located on the Earth's surface? ● Can the locations of volcanoes and earthquakes help predict future activity?

Standard 5.6 **Earth and Space Science**

The student will learn about the patterns, cycles, and changes in the Earth.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand Earth's patterns, cycles, and changes.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: *Weathering, erosion, deposition, plate tectonics, Rock Cycle, igneous, sedimentary, metamorphic, fossils* ● Identify rocks as igneous, sedimentary, metamorphic. ● Explain the Rock Cycle and how transformation occurs between rocks. ● Describe the differences between weathering, erosion, and deposition. ● Identify the influence of human impact on weathering, deposition, and erosion. ● Describe how fossil evidence helps to explain the Earth's history	● How are igneous, sedimentary, and metamorphic rocks formed? ● What are the forces that cause the Rock Cycle to occur? ● How do rocks transform throughout the Rock Cycle? ● What are the causes of weathering, erosion, and deposition? ● How does human impact contribute to weathering, erosion, and deposition? ● How do fossils provide evidence for Earth's history?

Standard 5.7 **Life Science**

The student will understand basic cell structure and learn about scientific classification.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate organisms with one or more cells and the characteristics that play an important role in the survival and the thriving of organisms in the environment.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
Vocabulary: cell membrane, cell wall, cytoplasm, chloroplast, nucleus, mitochondria, vacuoles, ATP. DNA, genes, circulatory system, respiratory system, skeletal system, digestive system, Kingdom, Phylum, Class, Order, Family, Genus, Species, Vertebrates, Invertebrates, Vascular plants, Nonvascular plants ● Identify basic cell structures and their functions. ● Describe how organisms are classified using physical characteristics, body structure and behavior. ● Identify traits that permit organisms to survive and thrive in their environment. ● Develop an interest, sense of wonder, and curiosity about the study of Life Science while recognizing the objective nature of science with respect to God as Creator.	● What are the basic cell structures of animals and plants? ● What is the function of each cell structure? ● How are organisms classified into Kingdom, Phylum, Class Order, Family, Genus, and Species? ● How does the human body systems work together to help the human body survive and thrive? ● What are the behaviors and adaptations of organisms to help them adapt to changes in their environment?

6th Grade

Life Science

The student will:

- learn about scientific and engineering practices.
- apply computation skills to data analysis and interpretation.
- understand all living things are composed of one or more cells that support life processes.
- investigate and understand there are levels of structural organization in living things.
- investigate and understand organisms reproduce and transmit genetic information to new generations.
- investigate and understand there are chemical processes of energy transfer which are important for life.
- learn the important role plants play in maintaining life.
- investigate and understand that biotic and abiotic factors affect an ecosystem.
- investigate and understand how populations in a biological community interact and are interdependent.
- investigate and understand how adaptations support an organism's survival in an ecosystem.
- investigate and understand ecosystems, communities, populations, and organisms are dynamic and change over time.
- investigate and understand relationships between ecosystems dynamics and human activity.

Standard 6.1

The student will learn about scientific and engineering practices.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate an understanding of scientific and engineering practices.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● asking questions and defining problems ● Describe the differences between Scientific Method and experimental design. ● planning and conducting investigations ● interpreting, analyzing, and evaluating data. ● constructing and critiquing conclusions and explanations ● developing and using models ● obtaining, evaluating, and communicating information	● What are the elements of the Scientific Method/Experimental Design? ● What are the differences between hypothesis, theory, and law? ● How are the elements of the experimental design used in problem solving? ● How are models used to explain broad concepts? ● How is data interpreted to drive outcomes?

Science 6.2

The student will apply computation skills to data analysis and interpretation.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate mastery of computational skills.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Ability to interpret graphs, charts, and tables. • Use of rations (fractions, percents and decimals) • Use of metric system • Use of scales (in relation to ratios) • Solve rate problems using both metric and English units	• What is the foundation of the metric system compared to English system? • How are descriptive statistics used in analyzing data in graphs, charts, and tables? (Frequency distribution)

Standard 6.3

The student will understand all living things are composed of one or more cells that support life processes.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Describe cell theory. b. Explain how the development of cell theory demonstrates the nature of science. c. Identify cell structure and explain how organelles support life processes. d. Describe how the similarities and differences between plant and animal cells determine how they support life processes. e. Understand cell division as the mechanism for growth and reproduction. f. Explain why cellular transport (osmosis and diffusion) is important for life processes.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● make connections among the components of the nature of science, their investigations, and the greater body of scientific knowledge and research. ● differentiate between a scientific hypothesis, theory, and law. ● identify the three components of the original cell theory. ● provide examples to illustrate how the development of cell theory illustrates the nature of science. ● ex~~plain how~~ advances in microscope technology have improved our understanding of cells and their parts. ● conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells ● identify and relate cellular organelles (cell membrane, cytoplasm, nucleus, cell wall, vacuole, mitochondrion, endoplasmic reticulum, and chloroplast) with the life processes they perform within a living cell. ● develop and use a model to demonstrate how organelles function as a system to conduct life processes within the cell. ● evaluate limitations of models to accurately represent the cell and its organelles. ● compare plant and animal cells and their parts, using microscopes and microscopic images. ● explore differences in the structure and function of animal and plant cells. ● relate the parts of a cell to the life functions they perform within the cell.	● How does cell theory help us understand living things through the use of the microscope? ● How are animal cells, plant cells, viruses, and bacterial cells similar and different? ● What are cell organelles, their processes and how do they relate to their functions?

• explain how the parts of a cell work as a system to conduct life processes in the cell and the organism. • sequence the steps and recognize images of each stage in the cell cycle, including mitosis. • identify and explain the role of each stage of mitosis to ultimately support successful cell division. • explain why cell division is essential to the growth and reproduction of all living things. • differentiate between the purpose of mitosis and meiosis. • model how materials move into and out of cells in the processes of osmosis, diffusion, and selective permeability. • predict and provide an explanation to account for the net movement of materials across a selectively permeable membrane during osmosis and diffusion.	

Standard 6.4

The student will investigate and understand there are levels of structural organization in living things.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Identify patterns of cellular organization to support life processes. b. Understand unicellular and multicellular organisms have comparative structures. c. Describe how similar characteristics determine the classification of organisms.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● explain the relationship among cells, tissue, organs, and organ systems. ● differentiate among common examples of unicellular and multicellular organisms. ● compare how unicellular and multicellular organisms perform various life functions, including the application of knowledge about systems in organisms and division of labor. ● provide evidence to support the idea that a cell's form fits its function within a multicellular organism. ● classify organisms based on a comparison of key physical features and activities. ● arrange organisms in a hierarchy according to similarities and differences in features. ● apply classification criteria to categorize examples of organisms as representatives of the three domains: Archaea, Bacteria, and Eukarya ● apply classification criteria to categorize examples of four kingdoms of Eukarya: protists, fungi, plants, and animals. ● apply classification criteria to categorize examples of organisms as representative of major animal phyla and plant divisions. ● recognize scientific names as part of a binomial nomenclature.	● What is ATP and how is it used in the cell? ● How do heterotrophs and autotrophs use ATP? ● What are the stages of cell division? ● How are these stages different in unicellular vs multicellular organisms? ● What is homeostasis in reference to the cell? ● What is the level of organization for living things?

Standard 6.5

The student will investigate and understand organisms reproduce and transmit genetic information to new generations.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Discuss how DNA has a role in making proteins that determine organism traits. b. Explain the role of meiosis in transferring traits to the next generation. c. Use Punnett squares as mathematical models to predict the probability of traits in offspring.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● state contributions of Gregor Mendel ● state the contributions of Charles Darwin ● use a variety of models to investigate the structure of DNA (LS.10 a) ● Describe the structure and function of DNA. ● discuss how the contributions and discoveries leading to our current understanding of DNA, genes, chromosomes, and traits illustrate the nature of science. ● explain the relationship among genes, chromosomes, and alleles. ● explain that DNA contains coded instructions that store and pass on genetic information from one generation to the next ● 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. ● compare genetic variation of offspring produced from sexual and asexual reproduction. ● explain the significance of gametes contributing half of their genetic material through sexual reproduction. ● differentiate between characteristics that can be inherited and those that cannot be inherited. ● distinguish between dominant and recessive traits. ● use Punnett squares to predict the possible genetic combinations and phenotype expressions from single trait crosses using dominant and recessive traits.	● What did Gregor Mendel contribute to the study of genetics? ● How are alleles used to identify genetic traits? ● How are dominant and recessive traits passed from one generation to another? ● How can Punnett squares be used to predict genetic outcomes? ● Why is the study of heredity important for understanding human health?

Standard 6.6

The student will investigate and understand there are chemical processes of energy transfer which are important for life.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize photosynthesis is the foundation of virtually all food webs. b. Understand photosynthesis and cellular respiration support life processes.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● 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. ● relate the importance of photosynthesis to the role of producers as the foundation of food webs. ● plan and conduct an investigation related to photosynthesis. ● explain how organisms use energy stored from the products of photosynthesis. ● demonstrate an understanding of the interaction of reactants, products, plant parts, and cellular organelles in the process of photosynthesis. ● explain how the processes of photosynthesis and cellular respiration serve to make energy available for life processes within living systems. ● provide evidence to demonstrate the interdependence of photosynthesis and cellular respiration. ● develop a model of cellular respiration 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. ● discuss how matter and energy are conserved in chemical changes within biological systems (individual cells to ecosystems) ● create plausible hypotheses about the effects of changes in available materials on the rate of photosynthesis or cellular respiration; evaluate whether the hypotheses are testable in your laboratory and evaluate the hypotheses if possible.	● How do different organisms obtain energy to survive, grow, and reproduce? ● How are organisms named by using binomial nomenclature? ● How do scientists use classification as an organizational tool to identify organisms? ● Apply classification criteria to categorize examples of the 6 Kingdoms.

Standard 6.7

The student will learn the important role plants play in maintaining life.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate and understand the characteristics of plants.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• State differences between plant and animal cells. • Describe plant reproduction including the reproductive parts of a plant. • Explain the process of photosynthesis including the reactants and products in the chemical process.	• What are the differences between plant and animal cells as seen through a microscope? • What is the function of the reproductive parts of a plant? • What is the relationship between photosynthesis and energy?

Standard 6.8

The student will investigate and understand that biotic and abiotic factors affect an ecosystem.

Benchmarks
Key knowledge and skills we want students to know and be able to do

a. Understand matter moves through ecosystems via the carbon, water, and nitrogen cycles.
b. Explain how energy flow is represented by food webs and energy pyramids.
c. Describe the relationships that exist among producers, consumers, and decomposers.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● differentiate among key processes in the water, carbon, and nitrogen cycles and provide examples to illustrate how they support life. ● develop and/or use a model to illustrate the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ● analyze local aquatic and terrestrial ecosystems, identify biotic and abiotic components, and describe their roles in the cycling of matter and flow of energy. ● explain and provide examples to illustrate the cause-and-effect relationship of human activity on the cycling of matter and flow of energy in an ecosystem. ● explain matter and energy transfer as modeled through food webs and energy pyramids. ● determine the relationship between a population's position in a food web and its size. ● interpret energy pyramids to determine the relative amount of energy available at each trophic level. ● develop and/or interpret a model of a food web using organisms found in a local ecosystem and classify organisms as producers or first-, second-, or third order consumers. ● recognize examples of common producers, consumers, and decomposers and explain the role of each in the flow of energy and cycling of matter through an ecosystem. ● provide examples to illustrate the effects of human activity on the activity of producers, consumers, and decomposers in an ecosystem.	● How does the predator/prey relationship impact the environment? ● Why is it important for organisms to have specific roles and relationships in a thriving environment? ● How can you show the transfer/flow of energy between organisms?

Standard 6.9

The student will investigate and understand how populations in a biological community interact and are interdependent.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand relationships exist between predators and prey and these relationships are modeled in food webs. b. Explain how the availability and use of resources may lead to competition and cooperation. c. Explain symbiotic relationships support the survival of different species. d. Understand how the niche of each organism supports survival.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● explain how the interactions of populations form communities within an ecosystem. ● formulate inferences based on graphs and other data about predator-prey populations. ● argue based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors help them to obtain resources. ● analyze and interpret data to predict and explain the effects of resource availability on organisms and populations in an ecosystem. ● predict the effect of limiting factors on organisms, populations, and/or communities in a food web/ecosystem. ● provide examples to illustrate how organisms cooperate and/or compete with one another for resources. ● analyze and interpret data about the effects of resource availability on organisms and populations of organisms in an ecosystem. ● differentiate among the types of symbiosis and recognize and/or provide examples of each. ● infer the niche of organisms from their physical characteristics.	● How do all the biomes interact together in the biosphere? ● What are the causes of immigration and emigration? ● What are the ways we can be stewards of the environment? (recycling)

Standard 6.10

The student will investigate and understand how adaptations support an organism's survival in an ecosystem.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Identify the biotic and abiotic factors that define land, marine, and freshwater ecosystems. b. Explain how physical and behavioral characteristics enable organisms to survive within a specific ecosystem.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● compare the biotic and abiotic factors that distinguish land, marine, and freshwater ecosystems. ● analyze and describe how physical characteristics and behaviors enable organisms to survive in an ecosystem. ● investigate how structural adaptations among populations allow organisms to survive with ecosystems.	● How do all the biomes interact together in the biosphere? ● What are the causes of immigration and emigration? ● What are the ways we can be stewards of the environment? (recycling)

Standard 6.11

The student will investigate and understand ecosystems, communities, populations, and organisms are dynamic and change over time.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Explain how organisms respond to daily, seasonal, and long-term changes. b. Explain how changes in the environment may increase or decrease population size. c. Explain how large-scale changes such as eutrophication, climate changes, and catastrophic disturbances affect ecosystems.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● categorize responses as daily, seasonal, or long-term. ● construct a scientific explanation based on evidence to explain the benefit(s) of daily, seasonal, and/or long-term responses of organisms to their enhanced survival. ● classify as long-term, short-term, or seasonal the various types of changes that occur over time in ecosystems, communities, populations, and organisms. ● predict the effect of changes to living and/or nonliving factors on the size and distribution of populations in an ecosystem. ● compare the factors that increase or decrease population size. ● argue, citing evidence, that changes to physical or biological components of an ecosystem affect populations. ● predict the effect of large-scale changes on ecosystems and communities. ● analyze data to determine the effect of a catastrophic event on a community. ● predict the environmental effects of large-scale changes, such as climate change, ocean acidification, and sea-level rise.	● How do all the biomes interact together in the biosphere? ● What are the causes of immigration and emigration? ● What are the ways we can be stewards of the environment? (recycling)

Standard 6.12

The student will investigate and understand relationships between ecosystem dynamics and human activity.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Explain how changes in habitat can disturb populations. b. Discuss how disruptions in ecosystems can change species competition. c. Determine how variations in biotic and abiotic factors can change ecosystems.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe ways that human interaction has altered habitats positively and negatively. ● Describe the relationship between human food harvest and habitat stability. ● debate the pros and cons of human land use vs. ecosystem stability. ● compare population disturbances that affect competition among species and species survival. ● use evidence to describe the impact of human activity on the biotic and abiotic factors within an ecosystem. ● interpret data obtained through observations and electronic and print resources to determine the effects of human interaction on local ecosystems. ● plan an investigation examining relationships between ecosystem dynamics and human activity. ● analyze and critique the experimental design of basic investigations related to the relationships between ecosystem dynamics and human activity.	● How do all the biomes interact together in the biosphere? ● What are the causes of immigration and emigration? ● What are the ways we can be stewards of the environment? (recycling)

7th Grade

Physical Science

The student will:

- learn about scientific and engineering practices.
- utilize models and measurements to learn physical science concepts.
- investigate and understand matter is composed of atoms.
- learn about atomic structure.
- investigate and understand that the periodic table is a model used to organize elements based on their atomic structure.
- investigate and understand that matter has properties and is conserved in chemical and physical processes.
- investigate and understand that waves are important in the movement of energy.
- investigate and understand that energy is conserved.
- investigate and understand that there are basic principles of electricity and magnetism.
- investigate and understand that work, force, and motion are related.

Standard 7.1

The student will learn about scientific and engineering practices.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Demonstrate understanding of scientific and engineering practices.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Asking questions and defining problems • Describe the differences between scientific methods and experimental design. • Planning and conducting investigations • Interpreting, analyzing, and evaluating data. • Constructing and critiquing conclusions and explanations • Developing and using models • Obtaining, evaluating, and communicating information • Use quantitative and qualitative analysis of data incorporating the SI system	• What are the elements of the Scientific Method/Experimental Design? • What are the differences between hypothesis, theory, and law? • How are the elements of the experimental design used in problem solving? • How are models used to explain broad concepts? • How is data interpreted to drive outcomes?

Standard 7.2

The student will utilize models and measurements to learn physical science concepts.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Incorporate the practices of science and engineering into the study of Physical Science.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Using mathematics and computational thinking including accuracy and precision. • Obtaining, evaluating, and communicating information • Describe the limitations of experimental design using measured quantities through significant figures. • Describe the use of appropriate technology for gathering and analyzing data and communicating results	• How are models used to explain physical phenomena such as Bohr Models, Atomic Models etc. • How are measurements used to promote accuracy and precision in the collection of experimental data? • How are different types of data used to communicate, analyze, and interpret results?

Standard 7.3

The student will investigate and understand that matter is composed of atoms.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand our understanding of atoms has developed over time. b. Understand how the periodic table can be used to predict the chemical and physical properties of matter. c. Explain the kinetic molecular theory and how it is used to predict and explain matter interactions.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Distinguishing between elements, compounds and mixtures provides examples to demonstrate how the development of atomic theory illustrates the nature of science. ● construct and use models and simulations to represent the structure of atoms; evaluate the limitations of models used. ● differentiate among scientific hypotheses, theories, and laws. ● interpret data in the periodic table to predict the chemical and physical properties of main group elements. ● construct and use models and simulations to represent and/or explain the atom and phases of matter; evaluate the limitations of models used, when appropriate ● 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. ● interpret diagrams representing different phases of matter. ● compose evidence-based conclusions, explanations, and arguments to identify changes in matter when thermal energy is added or taken away. ●	● How is matter classified? (Elements, compounds, mixtures, solutions) ● How are physical and chemical properties identified in matter? ● How are chemical and physical changes identified in matter? ● How are the four states of matter different? ● How are acids and bases identified using the pH scale? ● How do the different states of matter and their properties relate to each other?

Standard 7.4

The student will learn about atomic structure.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Investigate the atomic nature of matter.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Construct and explain models that illustrate the structure of the atom, including Bohr and electron cloud. ● Describe location, charge and relative size of protons, neutrons, and electrons. ● Describe the contributions of Dalton, Thomson, Rutherford, and Bohr to the atomic model Describe and identify physical properties and physical changes (including state, shape, density, color, odor, solubility) ● Explain the effect of temperature and particle size on solubility. ● Describe and identify chemical properties and physical changes (pH, reactivity, combustibility) ● Identify and classify acids, bases, salts. ● Describe solids, liquids, and gases. ● Describe solutions (saturated and supersaturated), suspensions and colloids.	● How and why has the atomic structure changed over time and who were its major contributors? ● How can we describe the structure of the atom? ● How can we physically represent the structure of an atom?

Standard 7.5

The student will investigate and understand that the periodic table is a model used to organize elements based on their atomic structure.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Obtain and explain information from the periodic table. symbols, atomic numbers, atomic mass, chemical groups (families), and periods are identified on the periodic table. b. Explain how elements are classified as metals, metalloids, and nonmetals.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Recognize symbols of elements, atomic number, and atomic mass ● Identify characteristics of families (groups) and periods ● Classify elements as metals, metalloids, and nonmetals. ● compare the location, charge, and relative mass of protons, neutrons, and electrons in a single atom. ● differentiate between atoms of an element and its isotopes. ● recognize that an atom's identity is related to the number of protons in its nucleus. ● use the periodic table to obtain the following information about the atom of an element: symbol, atomic number, and atomic mass. ● Describe the organization of the periodic table in terms of atomic number, metals vs. nonmetals, and groups vs. periods. ● use basic information provided for an element (atomic mass, atomic number, symbol, and name) to determine its place on the periodic table. ● recognize that the number of electrons in the outermost energy level determines an element's chemical properties or chemical reactivity. ● classify a given element as metal, nonmetal, or metalloid based on its position in the periodic table. ● given a chemical formula of a compound, identify the elements and the number of atoms of each that comprise the compound.	● How can the atomic number of an element be used to identify the individual number of atoms or molecules contained in an atom? ● How can the atomic mass number be used to identify the number of neutrons and isotopes of an atom? ● How are the elements arranged in the periodic table and what does their position tell us about their properties? ● How are different elements classified? ● What elements make up a compound?

Standard 7.6

The student will investigate and understand that matter has properties and is conserved in chemical and physical processes.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Identify pure substances based on their chemical and physical properties. b. Explain how pure substances can undergo physical and chemical changes that may result in a change of properties. c. Understand compounds form through ionic and covalent bonding. d. Balance chemical equations using models. e. Explain the conservation of matter.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe and identify evidence of chemical and nuclear reactions (including types of reactions, reactants/products, fission, fusion) ● Describe the nature of bonding: ionic and covalent. ● Write formulas and name compounds. ● State the law of theory of conservation of matter and energy. ● Use balanced chemical equations to describe chemical reactions to distinguish between physical properties and chemical properties of matter. ● generate, analyze, and interpret data in tables, graphs, charts, diagrams, and/or other displays related to physical and chemical properties of matter. ● apply mathematical and computational thinking to calculate and compare the densities of substances. ● identify and describe a pure substance based on its physical and/or chemical properties. ● provide examples of the specific uses of matter that are suited to their physical or chemical properties. ● plan and conduct investigations to explore the relationship among mass, volume, and density, collecting and analyzing data in metric units and the International System of Units (SI units) ● generate, analyze, and interpret data in tables, graphs, charts, and/or other displays related to mass, volume, and density. ● distinguish between physical and chemical changes. ● compose evidence-based conclusions, explanations, and arguments from data obtained in an investigation related to chemical changes in matter.	● How and why do elements form chemical bonds? ● What types of elements form ionic bonds? ● What types of elements form covalent bonds? ● How does the number of valence electrons determine the type and number of bonds an element forms? ● What are the different types of chemical reactions? ● How are chemical formulas written and named? ● How do we use the Law of Conservation of Matter to balance chemical equations?

● analyze and interpret diagrams and/or other displays to determine if a chemical or physical change has occurred. ● analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical change has occurred. ● use evidence and scientific reasoning to differentiate between a chemical reaction that requires an input of energy (endothermic) and one that releases energy (exothermic) ● apply scientific principles and the engineering process to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. ● differentiate among elements, compounds, and mixtures. ● apply scientific principles to develop a plan to separate a mixture. ● compare ionic and covalent bonding. ● apply scientific principles to predict if an ionic or covalent bond will form when main group metals and non-metals are chemically combined. ● identify the reactants and products in a given chemical equation. ● apply the law of conservation of matter to balance simple chemical equations.	

Standard 7.7

The student will investigate and understand that waves are important in the movement of energy.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Explain how energy may be transferred in the form of longitudinal and transverse waves. b. Understand mechanical waves need a medium to transfer energy. c. Explain how waves can interact. d. Discuss how energy associated with waves has many applications.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Define and calculate using SI units, wavelength, frequency, and speed of waves. ● Identify the parts of both a transverse and longitudinal wave, including wavelength, amplitude, trough, crest, rare faction, and compression as appropriate. ● Describe characteristics of sound, including resonance, reverberation, and interference. ● Describe the characteristics of light, including diffraction, reflection, refraction, and the electromagnetic spectrum. ● Compare and contrast concave and convex mirrors and lenses. ● Describe technological applications of sound and light. ● Describe the role of waves in transferring energy. ● explain the relationship between frequency and wavelength. ● construct and use models and simulations to represent waves, including how the amplitude of a wave is related to its energy. ● model a longitudinal (compression) wave and diagram, label, and describe the components (wavelength, compression, and frequency) ● model a transverse wave and diagram, label and describe the components (wavelength, amplitude, frequency, crest, and trough) ● compare longitudinal and transverse waves and their characteristics. ● plan and conduct investigations related to the refraction, reflection, and diffraction of longitudinal and transverse waves. ● develop and use a model to describe mechanical waves being reflected, absorbed, or transmitted through various materials. ● plan and conduct an investigation related to sound (the investigation may be a complete experimental design or may focus	● How do you hear sound? ● How do electromagnetic waves differ from each other? ● What causes waves? ● How is sound different when it travels through different media? ● What happens when two or more waves interact? ● How do you see visible light?

on systematic observation, description, measurement, and/or data collection and analysis) ● interpret graphs and charts to determine factors that determine the speed of sound through various materials. ● identify the property of a sound wave that corresponds to its loudness. ● apply scientific principles to compose an argument as to which of several wires of different lengths would produce the highest pitch sound. ● identify examples illustrating interference and/or resonance of transverse or longitudinal waves. ● evaluate and use credible, accurate, unbiased sources of print and electronic media to gather and summarize scientific and technical information about technological applications of sound and water waves and how each application functions.	

Standard 7.8

The student will investigate and understand that energy is conserved.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand energy can be stored in different ways. b. Understand energy is transferred and transformed. c. Understand energy can be transformed to meet societal needs.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe examples of potential and kinetic energy and the transformation between the two. ● Calculate potential and kinetic energy. ● Describe and calculate momentum. ● Differentiate between heat, mechanical, chemical, electrical, thermal, radiant, and nuclear energy. ● Describe the transfer of energy from one form to another. ● Describe the Law of Conservation of Matter and Energy ● Define and give examples of conduction, convection, and radiation. ● Describe the differences between fusion and fission. ● Research and describe applications of energy and alternative energy sources. ● identify and give examples of common forms of energy. ● recognize examples of energy causing change ● differentiate between kinetic and potential energy. ● plan and conduct observational and/or experimental investigations related to transformations of kinetic and potential energy. ● generate, analyze, and interpret data in tables, graphs, charts, diagrams, and/or other displays to compare relative amounts of potential and kinetic energy. ● construct and use models to show that different amounts of potential energy are stored in the system when the arrangement of objects interacting at a distance changes. ● plan and conduct experimental and/or observational investigations to provide evidence that energy can be transferred and transformed between its different forms.	● How are different forms of energy related? ● How is the thermal energy of a substance transferred? ● How is energy transferred and conserved? ● How does energy transfer explain change? ● How can we see energy? ● How is momentum conserved?

• identify the energy transformations that occur when energy is used to run a device in the home or school. • identify the energy transformations that occur between radiant energy in sunlight and the food we eat. • plan and conduct an investigation related to energy transfer through conduction, convection, and radiation. • generate, analyze, and interpret data in graphs, charts, diagrams, and/or other displays related to thermal energy transfer through conduction, convection, and radiation. • apply scientific principles to design, construct, and assess a device that either minimizes or maximizes thermal energy transfer. • compare Celsius and Kelvin temperature scales and use them to describe absolute zero. • explain absolute zero in terms of molecular movement (kinetic energy) • use scientific principles to explain the function of a thermometer. • analyze a time/temperature graph of a phase change to determine the temperature at which the phase change occurs (freezing point, melting point, or boiling point) • ask questions and define problems related to electrical energy production in Virginia. • describe energy systems, to include transformations in nature and those that are used to meet societal needs. • evaluate and use credible, accurate, and unbiased sources of print and electronic media to gather and summarize scientific and technical information to describe how energy and fuels (fossil, renewable, and nuclear) are derived from natural resources and how their uses affect the environment.	

Standard 7.9

The student will investigate and understand that there are basic principles of electricity and magnetism.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Recognize an imbalance of charge generates static electricity. b. Recognize materials have different conductive properties. c. Explain how electric circuits transfer energy. d. Describe how magnetic fields cause the magnetic effects of certain materials. e. Explain how electric current and magnetic fields are related. f. Discuss how many technologies use electricity and magnetism.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Investigate and explain static electricity including attraction and ● repulsion ● Explain current electricity using parallel and series circuits, alternating and direct currents. ● Describe the relationship between magnetic fields and electric currents. ● Explain the uses of electromagnets, motors, and generators. ● Differentiate between conductors, semiconductors, and insulators. ● Describe the technological applications of electricity and magnetism as it applies to appliances, electronics, and computers. ● model the transfer of electrons that results in a static charge. ● provide examples of materials that are good electrical conductors, semiconductors, and insulators. ● apply scientific principles and the engineering process to use a battery, several wires, and a bulb to determine if an object is an electrical conductor or insulator and create a model to help explain your solution. ● define and recognize examples of voltage, current, and resistance in electric circuits. ● construct simple series and parallel circuits to determine the relationship among voltage, resistance, and current. ● Describe the energy flow and transformation in a circuit containing a power source and no more than three loads. ● discuss the advantages of electronic over electrical circuits. ● evaluate and use credible, accurate, and unbiased sources of print and electronic media to gather and summarize scientific and technical	● How do magnetic poles interact? ● How can an electrical current produce a magnetic field? ● How is static electricity formed? ● How are series and parallel circuits different? ● How can a generator produce an electric current? ● How are electricity and magnetism related? ● How do the properties of magnets allow them to be useful to society?

information about current applications of semiconductors (e.g., diodes and transistors) ● 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. ● identify technologies that utilize electromagnetism. ● apply an understanding of electromagnetic induction to explain the current produced when a coil of wire is moved through a magnetic field. ● plan and conduct an investigation to determine the factors that affect the strength of electric and magnetic forces. ● compare generators and motors and how they function. ● identify everyday appliances and technologies that utilize motors and generators.	

Standard 7.10

The student will investigate and understand that work, force, and motion are related.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Describe motion using position and time. b. Describe motion using Newton's laws.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● apply the concept of frame of reference to motion scenarios. ● apply the concepts of speed, velocity, and acceleration when describing motion. ● compare the speed of two or more objects. ● develop hypotheses, identify constants, variables, and apply repeated trials when conducting experimental investigations related to motion. ● make measurements and apply mathematical and computational thinking to calculate and analyze speed, velocity, and acceleration. ● generate, analyze, and interpret data in tables, graphs, charts, diagrams, models, equations, and/or other displays related to motion) ● construct and use models and simulations to represent and/or explain motion. ● critique and improve an investigation about forces. ● plan and conduct 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. ● differentiate between mass and weight. ● plan and conduct investigations related to mass and weight, collecting and analyzing data in metric and SI units where appropriate. ● identify situations that illustrate each of Newton's laws of motion. ● apply an understanding of scientific principles and laws to describe and predict motion. ● construct and use models and simulations to represent and/or explain Newton's laws of motion. ● plan and conduct an investigation regarding Newton's second law of motion to show the relationship among force, mass, and acceleration. ● explain how force, mass, and acceleration are related. ● apply Newton's third law of motion to design a solution to a problem involving the motion of two colliding objects. ● state the direction of motion after the interaction of two objects.	● How do magnetic poles interact? ● How can an electrical current produce a magnetic field? ● How is static electricity formed? ● How are series and parallel circuits different? ● How can a generator produce an electric current? ● How are electricity and magnetism related? ● How do the properties of magnets allow them to be useful to society?

• explain how the concept of work, force, and motion apply to everyday uses and current technologies. • recognize the direction of the force of friction. • explain why force must be exerted continually to keep an object sliding across a carpeted surface. • recognize examples of mechanical work • apply mathematical and computational thinking to solve basic problems related to work. • make measurements and apply mathematical and computational thinking to calculate the power of an object. • use models to illustrate and explain concepts related to work and power. • Define and calculate using SI units speed, velocity, and acceleration. • Define and calculate using SI units work and force. • Describe use and application of simple and complex machines. • Describe the technological application of work, force, and motion. • State and apply Newton's laws of motion, also including the application of centripetal force and air resistance. • Describe and interpret motion graphs. Describe balanced and unbalanced forces as applied to motion.	

High School - Earth Science

The student will:

- understand the impact of science on human activities with respect to Catholic morality and beliefs.
- incorporate the practices of science and engineering into the study of Earth Science.
- demonstrate an understanding of scientific reasoning, logic, and the nature of science.
- investigate and understand that Earth is unique in our solar system.
- understand the Earth's place in the universe in relationship to the sun and moon.
- investigate and understand that many aspects of the history and evolution of Earth and life can be inferred by studying rocks and fossils.
- understand the earth's structure and understand the geological processes that take place on the planet.
- investigate and understand that there are major rock-forming and ore minerals.
- investigate and understand igneous, metamorphic, and sedimentary rocks.
- understand and appreciate the role of water on the Earth.
- investigate and understand that Earth's weather and climate are the result of the interaction of the sun's energy with the atmosphere, oceans, and land.
- understand the relationship between Earth and human activity.

Standard 1

The student will understand the impact of science on human activities with respect to Catholic morality and beliefs.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Address the importance of stewardship of the created Earth. b. Consider issues related to respect for life and care for the poor and vulnerable. c. Evaluate issues related to just use of resources and ecology. d. Display ethical decision-making.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Stewardship of Creation: Catholic teaching emphasizes the concept of stewardship, which means that humans have a responsibility to care for and protect the Earth. Students should learn about the ways in which human activities, such as deforestation, pollution, and climate change, can harm the environment and disrupt the balance of ecosystems. ● Respect for Life: Catholic morality emphasizes the dignity and sanctity of all life. Students should explore how human activities can have detrimental effects on biodiversity and ecosystems, leading to the loss of species and the destruction of habitats. This can involve studying topics such as habitat destruction, species extinction, and the importance of preserving biodiversity. ● Care for the Poor and Vulnerable: Catholic social teaching calls for special concern for the poor and vulnerable. Students should examine how environmental degradation caused by human activities can disproportionately affect marginalized communities and exacerbate social inequalities. This could involve studying issues such as environmental justice, access to clean water and air, and the impact of climate change on vulnerable populations. ● Just Use of Resources: Catholic teaching emphasizes the responsible and just use of Earth's resources. Students should learn about the finite nature of resources, such as fossil fuels, and the consequences of their overconsumption. This can involve studying topics like sustainable development, renewable energy sources, and the ethical implications of resource extraction. ● Integral Ecology: Pope Francis's encyclical "Laudato Si"' highlights the interconnectedness of environmental, economic, and social issues.	● What are the teachings of the Catholic Church with respect to Earth Science topics? ● How does one study and practice the study of earth systems with the stewardship of the environment in mind?

Students should explore how human activities impact not only the physical environment but also human communities and social systems. This can involve studying topics like the circular economy, sustainable agriculture, and the importance of community engagement in addressing environmental challenges. ● Ethical Decision Making: Students should develop critical thinking skills and ethical reasoning to evaluate the environmental choices and dilemmas they may encounter. They should learn how to apply Catholic moral principles to analyze and make informed decisions about issues related to Earth and space science, such as climate change policies, conservation efforts, and sustainable practices.	

Standard 2

The student will incorporate the practices of science and engineering into the study of Earth Science.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. Asking questions and defining problems. b. Developing and using models. c. Planning and conducting investigations. d. Using mathematics and computational thinking. e. Understanding the limitations of measured quantities through the appropriate use of significant figures and error analysis. f. Constructing explanations and designing solutions. g. Engaging in argument from evidence. h. Understanding the use of appropriate technology for gathering and analyzing data and communicating results. i. Applying known facts and principles to solve new problems or evaluate new situations.

Standard 3

The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Scientific investigations are planned and conducted using the scientific method. b. Appropriate technology is used.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Observations are recorded properly. ● Living organisms are treated respectfully and used appropriately. ● Chemicals and equipment are used safely. ● Communication of results involves writing scientifically with the use of scientific literature. ● Alternative scientific explanations and models are recognized and analyzed. ● Scientific hypotheses, theories, and laws are differentiated from non-scientific usage of these terms. ● Mathematical manipulations including SI units, scientific notation, equations, graphing, ratios and proportions, significant figures and dimensional analysis are completed properly. ● Use of appropriate technology will produce meaningful data. ● Data are able to be analyzed and presented in many different forms. ● Models and simulations are valuable additions to or alternatives for some types of bench work.	

Standard 4

The student will investigate and understand that Earth is unique in our solar system.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand God took the chaos of the cosmos and gave structure and order, thus creating the Universe. b. Understand the big bang theory as the current scientific explanation of God's creation and origin of the universe. c. Understand stars, star systems, and galaxies change over extended periods of time. d. Describe the characteristics of the sun, planets, and their moons, comets, meteors, asteroids, and dwarf planets as determined by materials found in each body. e. Understand the evidence attained through space exploration has increased our understanding of the structure and nature of our universe. f. Describe how Earth supports life because of its relative proximity to the sun and other factors. g. Understand that the dynamics of the sun-Earth-moon system cause seasons, tides, and eclipses.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe the beginnings of the Universe with a discussion of the Big ● Bang Theory. ● Understand the Earth and its role in the solar system as part of the Milky Way System. ● Describe the position and motion of the Earth and Moon in reference to the sun in the solar system including space expiration and technology. ● Recognize units associated with measurements and distances in space, i.e., AU. ● describe the big bang theory and provide evidence used to support the theory. ● compare the characteristics and evolution of more massive stars to that of the sun. ● relate Earth's ability to sustain life to the sun's current stage in its stellar evolution and proximity to the Earth. ● use the Hertzsprung-Russel diagram to classify stars and use this classification to determine the projected stellar life cycle. ● analyze the variations in chemical compositions of stars of different masses and relate to the process of fusion and the star's stage in its stellar evolution.	● What are the events described in the Big Bang Theory? ● How does the position of the Earth in the Solar system affect the conditions on our planet? ● How does the rotation of the Earth affect the Earth's seasons? ● How do we know that the universe is continuously expanding?

• understand the connection between fusion of elements in stars and the presence and abundance of elements that make up our solar system and its contents, including living organisms. • analyze recent research findings (i.e., from NASA) about the terrestrial and gaseous planets; compare their atmospheres, internal composition, surface conditions, size, and rotation; and interpret why each planet has such characteristics as related to nebular theory. • compare the classification of the dwarf planet Pluto to the planets in relation to its orbit, and its similarity to other objects in the Kuiper Belt • compare the defining characteristics among moons, comets, meteoroids, and asteroids. • describe how technology (e.g., Galileo's telescope, Hubble telescope, planetary orbiters, landers/rovers) has contributed to our scientific understanding of the cosmos.	

Standard 5

The student will understand the Earth's place in the universe in relationship to the sun and moon.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Describe the relationship between the sun, moon, and the Earth in the universe as it affects human life on Earth.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Recognize that the solar system consists of the sun, the planets and their moons, asteroids. comets and meteors, held in orbit around by the Sun's gravitational pull. • Compare the relative sizes and distances of the sun, moon, and Earth to other bodies in the universe. • Describe the planets in terms of the relationship to the sun. • Describe the relationship between the Earth, moon, and sun in terms of tides, eclipses, seasons, magnetism, gravity, and the phases of the moon. • Describe how nuclear fusion and other processes produce energy in the sun and other stars. • Describe the patterns of solar activities on the sun as related to auroras, radio and satellite communication and power grid disturbances. • Describe how the Hertzprung- Russell (H-R) diagram can be used to classify the stars.	• What are the positions of the Earth and the other celestial bodies in reference to the sun? • How do the sizes of the sun, moon and Earth allow for Earth to be inhabitable? • How does the position of the Earth in the solar system affect the cycles of day and night? • How does the rotation and revolution of the Earth affect the seasonal cycles? • How does the moon's orbit around the Earth change the view of the moon from Earth including its phases? • What are the parts of the sun which affect communications and life on Earth? • How does the Earth's magnetic field and the Earth's gravitational pull affect life on Earth.

Standard 6

The student will investigate and understand that many aspects of the history and evolution of Earth and life can be inferred by studying rocks and fossils.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand traces and remains of ancient, often extinct, life are preserved by various means in sedimentary rocks. b. Recognize superposition, cross-cutting relationships, index fossils, and radioactive decay as methods of dating rocks and Earth events and processes. c. Understand absolute (radiometric) and relative dating have different applications but can be used together to determine the age of rocks and structures. d. Recognize rocks and fossils from many different geologic periods and epochs are found in Virginia.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe how evidence from rocks allows understanding of the age of the earth. ● Describe how geologic layers, radioactive dating, and evidence from fossils are used to indicate the Earth's age. ● Describe the processes of soil development including Karst Topography ● Describe how life has changed and become more complex over geologic time. ● Explain short- and long-term global occurrences and assess proposed explanations as related to mass extinctions (short-term occurrences include asteroid/comet impacts, volcanism, earthquakes; long-term occurrences include continental collisions, climate collapse, global glaciation) ● Using a geologic history diagram (cross section) sequence the order of events from oldest to youngest and identify cross-cutting relationships. ● Analyze data and graphs concerning the ratio of parent isotopes to daughter decay products present in a rock to calculate the age of the material based on absolute dating and assess how radioactive decay provides a reliable method to determine the age of many types of organic and inorganic materials. ● Analyze and interpret complex cross sections using both relative and absolute dating to sequence and define the geologic history of the section.	● What is the difference between relative and absolute dating? ● What is the Law of Superposition and the Law of Horizontality? ● What are the five mass extinction events and what are their similarities in terms of causation and subsequent recovery of biodiversity? ● What processes have occurred (occur) that hinder the study of Earth's history (glaciation removing ⅛ of the record) ● What are the essential conditions for Karst Topography?

• Analyze a sequence of rocks in terms of types, textures, composition, fossils, structural and weathering features to infer the history of the sequence over time. • Use index fossils to infer the geologic history of a complex cross section. • Analyzing rock and fossil evidence and other scientific data to depict an evolution of Earth's geologic, oceanic, and atmospheric conditions over time.	

Standard 7

The student will understand the earth's structure and understand the geological processes that take place on the planet.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand convection currents in Earth's interior lead to the movement of plants, creation of the magnetic field, and the distribution of materials in Earth's layers. b. Describe the features and processes which occur within plates and at plate boundaries. c. Explain how interactions between tectonic plates cause the development of mountain ranges and ocean basins. d. Identify evidence of geologic processes is found in Virginia's geologic landscape.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Describe the interior of the Earth in terms of physical and chemical changes in Earth's materials such as the crust, mantle, and inner and outer cores. ● Describe the lithosphere and the asthenosphere of the Earth. ● Describe the Theory of Plate Tectonics and Continental Drift ● Describe the movement of Earth's oceanic and continental plates including features formed such as Earthquakes and Volcanoes ● Describe the process of convection and how it affects seafloor spreading and the creation of mid ocean ridges and other topographical features of the ocean floor. ● Diagram three types of plate boundaries (divergent, convergent & transform) and describe geographic features associated with each boundary. (i.e., continental rifts, volcanic and island arcs, deep-sea trenches, transform faults). ● Describe the characteristics, formations, and sizes of earthquakes at plate boundaries and the effects the earthquakes have on human habitats. ● Describe the characteristics, formations, and types of volcanoes in reference to plate boundaries and the effects the volcanoes have on human habitats. ● use available data (seafloor age, magnetic information, seismic profiles, laser-measured motion studies, fossil evidence, rock types, tectonic history) to support plate tectonics theory. ● analyze the scientific evidence for plate motion, multiple continental collisions, and rifting events over the last billion years.	● Why do we have earthquakes, volcanic eruptions, hot spots, and mountains? ● What is the internal structure of the Earth? ● How are earthquakes and volcanoes similar and different? ● How are different landforms made? ● How did scientists develop theories about and study how the Earth changes? ● What evidence supports the theory of plate tectonics and continental drift? ● How has Earth's structures and composition changed its geological features over time? ● How do lithospheric plates move through convection? causing geologic features at different plate boundaries? ● What are the major topographical features of the ocean floor?

• comprehend and apply the details of plate tectonics theory to the formation of continents, mountain chains, island arcs, deep open trenches, earthquake zones, and continental and mid-ocean volcanism. ● model the composition and structure of the continental and oceanic lithosphere in terms of topographic features, density, thickness, and rates of motion. • compare different types of plate boundaries and resulting features. Cite current examples of convergent, divergent, and transform boundaries. ● analyze data on the speed, behavior, and paths of different types of seismic waves and determine Earth layer composition, density, and viscosity. ● analyze field and laboratory evidence and construct an explanation for the various structures produced in convergent continental and oceanic plate boundaries. • interpret the tectonic history of an area based on the sequences, structures, and type of rocks found in that area. • compare the tectonic activity of the east coast and the west coast of North America ● integrate the rock cycle with plate tectonics theory and determine how this is reflected in the geology of Virginia's five physiographic/geologic provinces. ● interpret landforms, water features, elevation and elevation changes, and other pertinent features on topographic maps. ● construct profiles from topographic contours • label on a map the physiographic provinces of Virginia • comprehend the topographic, rock-type and geologic-structural characteristics of each physiographic province of Virginia. ● analyze the geology of Virginia in terms of the rock structures, types, ages, and topography represented in the five physiographic provinces and reconstruct a geologic history. ● integrate and interpret the rock cycle, plate tectonics, and Virginia's geology.	

Standard 8

The student will investigate and understand that there are major rock-forming and ore minerals.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand analysis of physical and chemical properties supports mineral identification. b. Identify characteristics of minerals to determine the uses of minerals. c. Understand rock-forming minerals originate and are formed in specific ways.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Describe the characteristics of minerals. • Identify minerals by the elements contained. • identification tests which include Mohs Scale for Hardness, streak, luster, specific gravity, color, and texture. • Describe and identify the three different types of rocks (igneous, sedimentary & metamorphic) • Trace the remains of ancient life, preserved by various means in sedimentary rock. • relate the abundance of mineral-forming elements with the processes and conditions required to form them. • identify minerals at or near Earth's surface and relate these to the Earth's general structure, plate tectonics, and chemical and physical weathering. • relate how the structure and composition determine the properties of silicates, carbonates, and oxide minerals. • relate cleavage patterns of minerals to atomic structure and bonding arrangement. • plan and conduct an investigation to identify minerals based on their physical and chemical properties, such as hardness, color, luster, density (specific gravity), cleavage, fracture, streak, and effervescence) • identify formation processes by attributes observed in rock-forming and ore mineral samples. • utilize a table of mineral properties to identify and/or classify an unknown mineral. • explain the uses and importance of ore minerals. • describe the conditions needed to create large and small crystals.	• What process accounts for the origins of minerals from magma? • What features are used to identify minerals and rocks? • How are rocks formed and classified? • Why is the rock cycle considered a cycle? • What are the internal and external processes evident in the rock cycle? • What role does temperature and pressure play in the formation of rocks? • How is the study of rocks and minerals applicable to the geographic processes of the state of Virginia?

Standard 9

The student will investigate and understand igneous, metamorphic, and sedimentary rocks.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand Earth materials are finite and transformed over time. b. Use rock cycle models to explain the transformation of rocks. c. Identify the layers of Earth as rocks with specific chemical and physical properties. d. Explain how plate tectonic and surface processes transform Earth materials.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Describe and identify the three different types of rocks (igneous, sedimentary & metamorphic) • Trace the remains of ancient life, preserved by various means in sedimentary rock. • Distinguish between intrusive and extrusive igneous, clastic, and non-clastic sedimentary and foliated and nonfoliate metamorphic rocks. • Describe the processes that change one rock into another in the rock cycle. • Describe and identify Virginia landforms, including rocks, minerals, and fossils as well as their locations in the physiographic provinces of Virginia. • explain how the model of the rock cycle demonstrates conservation of matter and energy. • relate the size of igneous crystals (texture) with rate and location of cooling. • model and interpret a vertical sequence of rocks and label the rock types and the related features in the sequence. • describe characteristics of metamorphic and sedimentary rocks • classify rock types as igneous, metamorphic, or sedimentary. • plan and conduct an investigation to identify an unknown rock sample based on chemical and physical characteristics. • differentiate between clastic and non-clastic (chemical, and biological/organic) sedimentary rocks. • compare distinguishing characteristics of the crystal structure and textures of extrusive and intrusive igneous rocks. • differentiate between the structure of foliated and non-foliated metamorphic rocks.	• What process accounts for the origins of minerals from magma? • What features are used to identify minerals and rocks? • How are rocks formed and classified? • Why is the rock cycle considered a cycle? • What are the internal and external processes evident in the rock cycle? • What role does temperature and pressure play in the formation of rocks? • How is the study of rocks and minerals applicable to the geographic processes of the state of Virginia?

• explain how surface processes and Earth's movement relate to rock formations and the availability of rock.	

Standard 10

The student will understand and appreciate the role of water on the Earth.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand water impacts geologic process including soil development and karst topography. b. Understand the nature of materials in the subsurface affect the water table and future availability of fresh water. c. Understand weather and human usage impact freshwater resources, including water locations, quality, and supply. d. Explain how stream processes and dynamics impact the major watershed systems in Virginia, including the Chesapeake Bay and its tributaries.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas

• Describe gyres as a result of oceanic circulation.
• Describe ocean currents in terms of temperature, salinity, density, and global patterns.
• Describe physical and chemical changes related to tides, waves, currents, salinity, upwelling, and sea level variations.
• Compare and contrast surface water systems, such as oceans, lakes, rivers, streams, and wetlands.
• Describe how the Chesapeake Bay was formed and identify its major watersheds.
• interpret a hydrologic cycle diagram, including evaporation, condensation, precipitation, transpiration, infiltration, underground storage, and runoff.
  ◦ examine the formation of karst in terms of rock type, solubility and permeability, uplift, the water table, and chemical and physical weathering.
• interpret a simple groundwater diagram showing the zone of aeration, the zone of saturation, the water table, and an aquifer.
  ◦ examine the presence of groundwater in various types of rock terrains, including areas found in each of the physiographic/geologic provinces of Virginia.
• gather and synthesize information about groundwater issues (groundwater withdrawal, recharge rates, saltwater intrusion, septic migration, chemical waste leakage, land subsidence), and describe potential consequences, including short- and long-term availability of the resource.
• plan and conduct an investigation to determine the effects of human activities on local freshwater sources.
	• Where is the water, both fresh and salt, located on Earth? How much of this water is usable by humans?
	• What effect does ocean water have on the nearby land?
	• What is the relationship between water salinity and density?
	• How are ocean currents powered?
	• What steps comprise the water cycle?

● use data to identify a freshwater problem in the community and propose a solution(s) • locate the major Virginia watershed systems (i.e., Chesapeake Bay, Gulf of Mexico, and North Carolina sounds) on a map. ● utilize topographic maps, to trace and delineate a Virginia watershed utilizing geologic and topographic evidence.	

Standard 11

The student will investigate and understand that Earth's weather and climate are the result of the interaction of the sun's energy with the atmosphere, oceans, and land.

Benchmarks
Key knowledge and skills we want students to know and be able to do

a. Explain that weather involves the reflection, absorption, storage, and redistribution of energy over short to medium time spans.
b. Understand weather patterns can be predicted based on changes in current conditions.
c. Understand extreme imbalances in energy distribution in the oceans, atmosphere, and the land may lead to severe weather conditions.
d. Explain how models based on current conditions are used to predict weather phenomena.
e. Understand changes in the atmosphere and the oceans due to human activity affect global climate.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Describe the water cycle and its relationship to weather. • Describe relative humidity, dew point, and their dependence on temperature. • Describe the composition and layers of the atmosphere including ozone depletion and effects of greenhouse gases. • Describe scientific evidence for changes in atmosphere composition over time. • Analyze data to find relationships between global temperatures and changes in atmosphere composition. • Investigate natural and human caused changes to the atmosphere. • Describe the relationship between ocean currents and global wind belts in terms of heat transfer as it affects the weather. • Explain the differences between maritime, continental, tropical and polar air masses. • Interpret basic information from weather maps including fronts, atmosphere pressure measurements, temperature, wind direction and cloud cover. • Describe the various conditions associated with the formation of severe weather, the resulting damage and social impact. • research and construct a diagram that demonstrates the interaction of solar radiation, Earth's atmosphere, and energy transfer (conduction, convection, and radiation) • predict the direction of local winds and relate these to the presence of fronts and high- and/or low-pressure systems or other	• What is the significance of the atmosphere to the existence of life on Earth? • What are some examples of severe weather and how have atmospheric conditions changed? • What are the layers of the atmosphere, in order, and how do they interact? • What are the characteristics of each layer of the atmosphere? • How do meteorologists use data to predict the weather? • How are maps used to forecast the weather? • What are universal meteorology symbols and tools? • How are the components of the water cycle related to weather? • What is the relationship between global wind systems and ocean currents? • What effect do air masses and wind direction have on weather? • How do the different types of clouds form? • How do human actions impact climate change?

atmospheric phenomena over a multi-day period, read and interpret data from a thermometer, a barometer, and a psychrometer; determine if there is a correlation between the data and observed weather phenomena • identify types and origins of air masses, fronts, and the accompanying weather conditions. • collect evidence for how the motions and complex interactions of air masses result in changes in weather conditions. • plan and conduct an investigation to predict weather based on cloud type, temperature, jet stream location, relative humidity, and barometric pressure. • read and interpret a weather map containing fronts, isobars, and isotherms and relate these factors to potential weather conditions occurring at specific locations. • analyze the conditions that lead to severe weather events such as tornadoes and hurricanes. • describe the effect of satellite technology on weather prediction and storm tracking, including hurricanes, and evaluate the costs and benefits in terms of lives and property saved; predict the impact on storm preparedness if there were no weather satellites. • Describe human and natural factors that have led to the rise in global temperature over the past century. • analyze geoscience data and the results of global climate models to make an evidence-based forecast of the current rate of global and regional climate change and associated future effects on Earth systems.	

Standard 12

The student will understand the relationship between Earth and human activity.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Understand global resource use has environmental liabilities and benefits. b. Explain how availability, renewal rates, and economic impact should be considered when using resources. c. Discuss the use of Virginia resources and their impact on the environment and the economy. d. Discuss how the selection of various energy sources has environmental and economic impacts.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Explain how water quality in the groundwater and surface systems is impacted by land use decisions. • Explain the types and benefits of wetlands as a natural resource. • Describe and classify renewable and nonrenewable resources and their effects on the environment. • Describe how the Earth is shaped by varying conditions in geology, atmosphere, and the hydrosphere. • construct an explanation based on evidence for how the availability of natural resources has influenced human activity. • relate the formation of fossil fuels (coal and natural gas) in terms of the rock cycle to ancient biologic and atmospheric/climatic conditions and changes within Virginia. • determine the sources of clean water in their community, analyze consumption and supply data, and forecast potential issues related to sustainability. • analyze how Virginia's production and use of various natural resources has changed over the last 150 years. • research and analyze various types of recent data (e.g., climate, agriculture, and biomass production) and evaluate Virginia's potential as a producer of renewable energy sources. • assess the role of fossil fuels and renewable energy sources in the future and compare the environmental benefits and costs among the various options. • analyze data concerning a range of emerging energy and mineral resources in Virginia in terms of costs and benefits and create an evidence-based forecast of trends and effects on the environment and economy	• How do the Earth's surface processes and human activities affect each other? • How do humans depend on Earth's resources? • How do humans change the planet? • How can natural resources be preserved?

High School - Biology

The student will:

- understand the impact of science on human activities with respect to Catholic morality and beliefs.
- incorporate the practices of science and engineering into the study of Biology.
- demonstrate an understanding of scientific reasoning, logic, and the nature of science.
- investigate and understand the chemical and biochemical principles essential for life.
- investigate and understand the relationship between cell structure and cell function.
- investigate and understand common mechanisms of DNA function, protein synthesis, and inheritance.
- investigate and understand the basis of modern classification methods.
- investigate and understand how populations change through time.
- investigate and understand dynamic equilibria between populations, communities, and ecosystems.

Standard 1

The student will understand the impact of science on human activities with respect to Catholic morality and beliefs.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Address the importance of stewardship of the environment. b. Provide background on the teachings of the Church related to i. stem cell research. ii. genetic engineering and cloning. iii. *in vitro* fertilization.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• understanding the various facets of stem cell research • the history of the development of genetic engineering • the role of the dignity of life when understanding reproductive issues such as *in vitro* fertilization	• What are the teachings of the Catholic Church in relation to biology topics such as stem cell research, genetic engineering, cloning, and *in vitro* fertilization?

Standard 2

The student will incorporate the practices of science and engineering into the study of Biology.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. Asking questions and defining problems. b. Developing and using models. c. Planning and conducting investigations. d. Using mathematics and computational thinking. e. Understanding the limitations of measured quantities through the appropriate use of significant figures and error analysis. f. Constructing explanations and designing solutions. g. Engaging in argument from evidence. h. Understanding the use of appropriate technology for gathering and analyzing data and communicating results.

Standard 3

The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Scientific investigations are planned and conducted using the scientific method. b. Appropriate technology is used. c. Use of the microscope is integral to the study of living things.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Observations are recorded properly. ● Living organisms are treated respectfully and used appropriately. ● Chemicals and equipment are used safely. ● Communication of results involves writing scientifically with the use of scientific literature. ● Alternative scientific explanations and models are recognized and analyzed. ● Scientific hypotheses, theories, and laws are differentiated from non-scientific usage of these terms. ● Use of appropriate technology will produce meaningful data. ● Data are able to be analyzed and presented in many different forms. ● Models and simulations are valuable alternatives for some types of benches work. ● Microscopes have become highly sophisticated and important tools for the study of biology. ● Both living and nonliving material may be examined under a microscope. ● Preparation of specimen for observation under the compound light microscope involves thin sectioning, staining, and adjustment of the light source.	● What are the steps to locating and focusing on an image seen under a microscope?

Standard 4

The student will investigate and understand the chemical and biochemical principles essential for life.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. The chemical properties of water shape the environment and support life on earth. b. Macromolecules are essential for cellular structure and function. c. Enzymes are necessary for many cellular activities. d. The processes of photosynthesis, chemosynthesis, and cellular respiration capture, transform, and store energy for cellular activities.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The water molecule contains two polar covalent bonds between the oxygen and hydrogen atoms. ● The water molecule is polar because of its uneven charge distribution. ● Hydrogen bonds form between water molecules or within large molecules such as proteins and nucleic acid. ● The oppositely charged regions of neighboring water molecules are attracted to each other producing the properties of cohesion, surface tension, high heat of vaporization (heat capacity) ● Oppositely charged regions of water and other molecules allow for the properties of adhesion and water's ability to dissolve polar or charged molecules. ● Macromolecules are based on carbon and are formed by cells using the process of dehydration synthesis and broken down by hydrolysis. ● Monomers are the units linked together to form polymers. ● Carbohydrate monomers are monosaccharides and are linked to form disaccharides and polymers. ● Carbohydrates play roles in energy production and storage and cell structure. ● Proteins are formed from amino acid monomers. The variety of amino acids enables a large variety of proteins. ● Protein structure has increasing levels of complexity: primary, secondary, tertiary, and possibly quaternary. ● A change in the structure of a protein will change the function of that protein. ● Proteins exhibit a wide variety of functions and function as enzymes, receptors, carrier molecules, immunoglobulins, molecules that	● Which aspects of water's structure contribute to its polarity? ● How do hydrogen bonds form? ● What are the properties of water that support life on earth? ● What are organic molecules? ● How are macromolecules synthesized and broken down by cells? ● What are the important structural features and functions of carbohydrates, proteins, lipids, and nucleic acids? ● What are some examples of each type of macromolecule that illustrate the key functions of that macromolecule? ● What does an enzyme do inside a cell? ● How does an enzyme do its job? ● What happens if the shape of an enzyme is altered? ● What is the difference between induced fit and denaturation? ● What environmental conditions affect enzyme activity? ● What is the relationship between synthetic processes of photosynthesis and chemosynthesis to respiration processes? ● Where does the energy to make carbohydrates come from? ● How do cells release energy from carbohydrates? ● What molecule contains the energy from food that the cells use for cell work? ● What is the role of oxygen in photosynthesis, aerobic respiration (and chemosynthesis)? ● What is the role of carbon dioxide in photosynthesis, aerobic respiration, and chemosynthesis? ● What is the difference between aerobic and anaerobic respiration in terms of ATP output?

produce movement and cell structures, and are rarely used as an energy source. ● Lipids do not form polymers. ● Biologically important lipids include triglycerides, phospholipids, and steroids. ● Nucleic acids are made of nucleotides. ● Nucleic acids such as DNA store the genetic information in the order of nucleotides while RNA molecules are responsible for producing proteins using the instructions in DNA. ● Most enzymes are proteins. ● Enzymes catalyze cellular reactions by lowering the energy of activation of the reaction. ● The chemical reaction takes place in the active site of the enzyme. ● Induced fit will align molecules that are being joined or stress bonds that need to be broken. ● Environmental influences on enzyme activity include pH, temperature, and salt concentrations. ● The energy for all ecosystems on earth comes from either the sun (photosynthesis) or inorganic molecules from the earth's crust (chemosynthesis). The energetic molecules made in these processes are used by organisms to produce ATP. ● During photosynthesis, organisms transform sunlight energy into chemical energy in carbohydrates. ● The process of photosynthesis requires water and carbon dioxide and produces glucose and oxygen. ● The energy for the production of carbohydrates from the process of chemosynthesis comes from inorganic molecules released from the earth's crust at hydrothermal vents or cold seeps. This energy is used to make carbohydrates from carbon dioxide. ● The process of cell respiration uses the products of photosynthesis to release the energy from the glucose molecules. ● Aerobic cellular respiration involves a series of metabolic reactions that break down glucose stepwise, releasing energetic electrons whose energy will be used to build up ATP. ● The process of aerobic respiration requires glucose and oxygen. The products are water and carbon dioxide. ● Key pathways in aerobic respiration are glycolysis, the Krebs cycle, and oxidative phosphorylation. ● Anaerobic respiration or fermentation produces ATP in the absence of oxygen.	

Standard 5

The student will investigate and understand the relationship between cell structure and cell function.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Cells are the basic unit of life. b. Organelles organize the cytoplasm of eukaryotic cells into functional sections. c. Cell membranes are phospholipid bilayers and play an important role in cell functions. d. . Cell size is determined by the ability of a cell to move materials across the plasma membranes and throughout the cytoplasm rapidly.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Cell theory was developed after many different people researched and supported each other's work with similar findings. • Prokaryotic cells represent the earliest, the simplest, and the most numerous forms of life. • Prokaryotic cells are divided into two domains, Bacteria and Archaea while all eukaryotic cells belong to the third domain Eukarya. • Eukaryotic cells are more complex than prokaryotic cells and have compartmentalized cytoplasm. • Organelles responsible for synthesis include the nucleus, ribosomes, • the endoplasmic reticulum, the Golgi body, and vesicles • Organelles involved in supplying energy include mitochondrion and the chloroplast. • Lysosomes and peroxisomes are responsible for the hydrolysis of cellular materials or worn-out organelles. • The cytoskeleton provides support for organelles and is responsible for cell shape and movement of materials within and outside the cell. • Highly specialized cells have modified organelles or additional structures such as microvilli and modified cell shapes and/or extensions. • All cells are enclosed in a phospholipid bilayer called the plasma membrane. • Phospholipid bilayers form spontaneously. • The internal membranes of eukaryotes are also phospholipid bilayers. • The fluid mosaic model describes the structure of the membrane.	• What is cell theory? • What features do all cells, prokaryotic and eukaryotic, have in common? • What differentiates prokaryotic cells from eukaryotic cells? • How do the structures of each organelle correlate to the organelle's functions? • How do the individual organelles contribute to the functioning of the entire cell? • What are some examples of specialized cells and what are their unique structures and functions? • How do specialized cells contribute to homeostasis of the entire organism? • What is the endosymbiotic theory and what evidence supports this theory? • How do phospholipid bilayers form spontaneously? • How do membranes separate and enhance cell metabolic activities? • What are the functions of various membrane proteins? • What are the effects of solutions with different concentrations of solutes and water on cell structure and function? • What happens to a cell that is unable to exchange materials with its environment rapidly? • Do large multicellular organisms have large cells? • Why are cells small? • Which is most important -- a large surface area, a small volume, or a large surface area to volume ratio?

• Selective permeability describes the function of the membrane. • Passive and active transport of materials, including water, occurs across the cell membranes. • Cell structure and function may change with changes in the concentrations of solutes and water in the environment. • Each membrane becomes specialized by the particular array of various proteins embedded in it. • Cells are small so that the surface area to volume ratio is maximized. • The rate of diffusion increases as surface area increases and decreases as volume or distance of diffusion increases. • However, the ratio of surface area to volume dictates cell size -- small cells have the greatest ratio and diffusion of materials across the plasma membrane and throughout the cytoplasm is rapid.	• Why is a large surface area to volume ratio important to normal cell function?

Standard 6

The student will investigate and understand common mechanisms of DNA function, protein synthesis, and inheritance.

Benchmarks
Key knowledge and skills we want students to know and be able to do

a. The cell cycle describes the activities of a cell from the time it is first formed to its division into two daughter cells.
b. Meiosis produces haploid gametes from diploid parent cells.
c. The work to determine DNA as the genetic material and its structure was performed by multiple scientists.
d. Complementary base pairing is the basis for DNA replication and RNA transcription.
e. Protein synthesis involves the formation of RNA from DNA and leads to the expression of inherited traits.
f. Cells in multicellular organisms become specialized or differentiated.
g. Inheritance of parental traits can be predicted using Mendelian laws of inheritance.
h. DNA technologies have advanced rapidly with the potential for misuse.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	Essential Questions Questions to guide student inquiry and focus instruction to uncover big ideas
● The cell cycle is divided into Interphase and the Mitotic phase during which normal cell activities and those leading to cell division occur. ● Mitosis divides the nuclear material while cytokinesis, occurring simultaneously, divides the cytoplasmic contents. ● Not all cells undergo mitosis. ● Some organisms produce offspring asexually by mitosis although asexual reproduction also includes fragmentation and budding. ● All organisms need to produce offspring and will do so by cell division. ● Prokaryotes use binary fission. ● Sexually reproducing organisms use meiosis to produce gametes. ● Genetic variety occurs during prophase I as crossing over occurs and during metaphase and anaphase I as homologous pairs are independently aligned and separated. ● Separation of homologous chromosome pairs occurs during meiosis I while the separation of sister chromatids occurs in meiosis II. ● Random fertilization also contributes to genetic variety. ● Hershey and Chase showed that DNA, not protein, was a genetic material. ● Contributions by Chargaff, Avery, and Franklin (and others) allowed Watson and Crick to determine the structure of DNA. ● The DNA molecule is double stranded with antiparallel strands. ● Complementary base pairing is essential for normal DNA structure and function.	● Why do cells divide? ● Why is it so important for DNA to be synthesized before mitosis begins? ● How are the replicated chromosomes shaped, arranged, and separated during mitosis? ● What are the consequences of abnormal cell division? ● What is a gamete and why must it contain the haploid number of chromosomes? ● How do the replicated chromosomes separate into daughter cells during meiosis? ● Why are two meiotic divisions required to make a haploid gamete? ● How does genetic variety occur? ● Why is genetic variety important? ● How are the nucleotide monomers of nucleic acids arranged in a DNA molecule? ● What is complementary base pairing and why is so important to DNA structure and function? ● How are DNA and RNA similar? How are these two molecules different? ● What is the role of mRNA, tRNA, and rRNA in protein synthesis? ● What is meant by stating that the genetic code is universal? ● Where in the cell do transcription and translation take place? ● What is the role of the ribosome in protein synthesis?

• DNA in eukaryotic chromosomes is associated with proteins called histone. • The two strands of DNA are held together by hydrogen bonds between complementary bases: adenine with thymine, cytosine with guanine. • DNA replication is semiconservative and involves multiple enzymes. • RNA molecules have uracil instead of thymine. • RNA molecules are formed from a DNA template and are used to synthesize proteins. • The central dogma of molecular biology (DNA replication, transcription, translation, and expression) relies on complementary base pairing. • The genetic code is universal and is read three nucleotides at a time as codons. • An mRNA transcript is formed, modified, and sent to the ribosomes in the cytoplasm. • The mRNA is translated at the ribosome by tRNA. • Each tRNA molecule carries an amino acid and an anticodon. • Each cell in the organism contains the exact DNA. • Differentiated cells have unique structures and functions based on the DNA segments that are expressed in that cell. • Stem cells are unspecialized cells that may give rise to multiple differentiated cell types. • Mendel described the laws of dominance, independent assortment, and segregation. • Punnett squares help to make predictions of genotypes and phenotypes of offspring. • Rules of probability can be applied to predictions of inherited traits. • Many traits do not follow Mendelian inheritance patterns. • Environmental factors also influence phenotypes. • DNA technologies have enabled characterization of the genomes of species and individuals. • This information has permitted description of new evolutionary links and medical applications such as cloning, use of genome-editing treatments, and possible genetic enhancements. • Use of these technologies may not respect life and human dignity and these considerations must be a key element of all uses of the technology.	• Which RNA molecule carries DNA's message? Which RNA carries information to translate the nucleotide sequence into an amino acid sequence? Which RNA molecule has the ability to catalyze the formation of peptide bonds? • What happens when the code in DNA or an RNA molecule is altered? • Why do cells need to be specialized in multicellular organisms? • Why does every cell not express every gene in its genome? • What was Mendel's contribution to genetics? • What is the expected ratio of genotypes and phenotypes after monohybrid and dihybrid crosses? • Why do sex-linked traits affect males more than females? • How many combinations of human genes are possible? • How are new DNA technologies beneficial to individuals and to society? • What are the risks of manipulation of the genome?

Standard 7

The student will investigate and understand the basis of modern classification methods.

Benchmarks
Key knowledge and skills we want students to know and be able to do

a. Three domains classify all living things on Earth.
b. Classification schemes rely on comparison of numerous features.
c. Interpretation of the fossil record and embryological processes relies heavily on structural features of organisms.
d. Modern classification schemes are built on molecular biological and biochemical similarities of organisms.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The first life forms on Earth were prokaryotic cells and had billions of years of evolution to diversify. ● Two domains of prokaryotes illustrate how diverse prokaryotes can be. ● Domain Bacteria includes multiple kingdoms with organisms such as disease-causing organisms, cyanobacteria, and bacteria involved in the nitrogen biogeochemical cycle. ● Domain Archaea includes multiple kingdoms with organisms such as extremophiles. ● Domain Eukarya includes all organisms with eukaryotic cells found in Kingdoms Protista, Fungi, Animalia, and Plantae ● Organisms with common ancestors will have similar traits. ● Scientific names (binomial nomenclature) often include descriptions of salient features of the organism. ● Homology is observed in the forelimbs of terrestrial tetrapods. ● Cladograms utilize the concept of derived characters from an ancestral form. ● Fossilized remains provide clues to the structures of extinct organisms. ● Interpretation of the fossil record show detailed connections between groups of organisms ● The fossil record shows change in populations over time. ● Early embryological development is remarkably similar in vertebrates. ● Comparison of the sequence of amino acids in proteins and the sequence of nucleotides in DNA can show evolutionary relationships. ● From these data phylogenetic trees are constructed	● How old is life on Earth? ● What were the first organisms? ● Where on Earth is life thought to have begun? ● What is meant by "life on Earth is microbial"? ● What are the major features of organisms in Domain Eukarya, Kingdoms Protista, Fungi, Animalia, and Plantae? ● How are organisms on earth classified? ● What are examples of features that show the common ancestry of a particular group of organisms? ● What information can be shown in a cladogram? ● What information can the fossil record provide? ● What are the limitations of using the fossil record to determine evolutionary relationships? ● What are some developmental processes shared between the major animal groups? ● What data are used to construct phylogenetic trees? ● What is the connection between similar proteins and common ancestors?

Standard 8

The student will investigate and understand how populations change through time.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Natural selection is the key to understanding how organisms have changed over time. b. Genetic variation, reproductive strategies, and environmental pressures impact population survival. c. Emergence of new species occurs as populations change. d. A large body of scientific evidence supports biological evolution.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Natural selection is the ability of organisms to survive and reproduce due to their expressed traits in their current environment. • The traits must be encoded in the DNA. • The unit of evolutionary change is the population. • Without adaptive traits, organisms do not survive or do not pass on favorable genes to their offspring. • Interspecific competition leads to differential survival and reproduction. • Natural selection may lead to the emergence of novel traits and new species. • Genetic variation occurs during meiosis and fertilization. • Reproductive strategies that lead to survival include those that increase genetic variation and permit survival of the offspring. • Environmental pressures select the organisms with the most favorable traits. • Some populations appear to accumulate changes gradually while others undergo short periods of rapid change followed by long period of equilibrium, or no change. • Speciation involves the formation of unique traits that permit survival as well as reproduction. • Evidence for evolution is contained in the fossil record, embryological processes, anatomy and physiology, and genetics and biochemistry.	• What is natural selection? • How does natural selection produce a population of organisms adapted for a given environment? • What happens to these populations if the environment changes? • What is the unit of evolution? • What is a mutation? • Are all mutations detrimental? • Why is genetic variation within a population important? • What are some pressures imposed by the environment that may alter a population's ability to survive? • What are some aspects of the environment that permits the formation of unique species? • What makes a species unable to hybridize with another species? • What evidence supports the concept of evolution? • Which of the types of evidence is most compelling in support of evolution?

Standard 9

The students will investigate and understand dynamic equilibria between populations, communities, and ecosystems.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Ecosystems are composed of biotic and abiotic factors. b. Communities have dynamic internal interactions. c. Nutrient cycling must occur within an ecosystem as energy flows through ecosystems. d. Succession in an ecosystem is a predictable change in the organisms making up the communities.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Abiotic factors determine the characteristics of populations that live in the ecosystem. ● Carrying capacity is the ability of the environment to support a population with the available resources. ● Populations are groups of individuals of the same species that interbreed and compete for resources in a defined area at the same time. ● Populations interact with other populations and the abiotic factors within their ecosystem. ● Microenvironments within larger ecosystems have unique conditions and support unique communities. ● Community interactions revolve around trophic relationships as energy moves through the trophic levels. ● Decomposers are important for normal nutrient cycling. ● Ecosystem carrying capacities determine population numbers of all species. ● Limiting factors to population growth may be biotic or abiotic. ● Types of growth generally follow either logarithmic or logistic patterns. ● Energy is interchanged between the organisms within an ecosystem. ● Decomposers are key to nutrient cycling within ecosystems. ● Biogeochemical cycles move important elements from reservoirs to living organisms. ● The water cycle, carbon cycle, nitrogen cycle, and phosphorus cycle most directly affect living organisms. ● While nutrients are conserved within an ecosystem, energy must continuously flow through an ecosystem.	● What are the abiotic factors most important to organisms in different ecosystems? ● What are some consequences of insufficient resources for a population and the community in which it exists? ● What organisms are expected on each level of the trophic pyramid? ● What is the role of decomposers in their ecosystems? ● What factors in an ecosystem determine the carrying capacity of the environment for a given species? ● What are the limiting factors to population growth? ● What are the major features of a logarithmic and logistic growth curve? ● What is the importance of water, carbon, nitrogen, and phosphorus to organisms? ● How have humans altered the carbon cycle and what is the effect of these alterations on living organisms? ● What are the energy sources for terrestrial and deep-sea ecosystems? ● What is the difference between primary and secondary succession? ● What forces initiate succession events? ● What is a climax community? ● How do ecosystems recover after human-initiated succession events?

• Primary succession involves the colonization of rock by living organisms. • Secondary succession starts the recolonization of soil by living things.	

High School - Chemistry

The student will:

- understand the impact of science on human activities with respect to Catholic morality and beliefs.
- incorporate the practices of science and engineering into the study of Chemistry.
- demonstrate an understanding of scientific reasoning, logic, and the nature of science.
- investigate and understand how atomic structure determines the placement of elements on the periodic table.
- investigate and understand the matter and energy are conserved in chemical reactions.
- investigate and understand common molar relationships.
- investigate and understand solutions behave in predictable and quantifiable ways.
- investigate and understand phases of matter as described by kinetic molecular theory.
- investigate and understand basic chemical properties related to organic chemistry and biochemistry.

Standard 1

The student will understand the impact of science on human activities with respect to Catholic morality and beliefs.

Benchmarks Key knowledge and skills we want students to know and be able to do	
e. Address the importance of stewardship of the environment. f. Consider issues related to manufactured chemicals in the environment. g. Evaluate issues related to nuclear energy.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The Earth is a closed system with finite resources. ● Manufactured molecules may be both beneficial and detrimental to Earth's systems. ● The use of nuclear energy has both short-term and long-term effects.	● What are the teachings of the Catholic Church with respect to Chemistry topics such as manufactured chemicals in the environment and nuclear energy? ● How does one study and practice chemistry with the stewardship of the environment in mind?

Standard 2

The student will incorporate the practices of science and engineering into the study of Chemistry.

Benchmarks Key knowledge and skills we want students to know and be able to do
j. Asking questions and defining problems. k. Developing and using models. l. Planning and conducting investigations. m. Using mathematics and computational thinking. n. Understanding the limitations of measured quantities through the appropriate use of significant figures and error analysis. o. Constructing explanations and designing solutions. p. Engaging in argument from evidence. q. Understanding the use of appropriate technology for gathering and analyzing data and communicating results. r. Applying known facts and principles to solve new problems or evaluate new situations.

Standard 3

The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science.

Benchmarks Key knowledge and skills we want students to know and be able to do	
c. Scientific investigations are planned and conducted using the scientific method. d. Appropriate technology is used.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Observations are recorded properly. ● Living organisms are treated respectfully and used appropriately. ● Chemicals and equipment are used safely. ● Communication of results involves writing scientifically with the use of scientific literature. ● Alternative scientific explanations and models are recognized and analyzed. ● Scientific hypotheses, theories, and laws are differentiated from non-scientific usage of these terms. ● Mathematical manipulations including SI units, scientific notation, equations, graphing, ratios and proportions, significant figures and dimensional analysis are completed properly. ● Use of appropriate technology will produce meaningful data. ● Data are able to be analyzed and presented in many different forms. ● Models and simulations are valuable additions to or alternatives for some types of benches work.	

Standard 4

The student will investigate and understand how atomic structure determines the placement of elements on the periodic table.

Benchmarks
Key knowledge and skills we want students to know and be able to do

a. Atomic numbers and average atomic mass are important characteristics of elements.
b. Radioactivity is the natural process of atomic nuclear decay.
c. Elements are arranged in periods and groups (families) in the periodic table.
d. Electron configurations illustrate electron location and energy and indicate reactivity of the element.
e. Placement of elements in the periodic table enables determination of elemental characteristics related to atomic radius, electronegativity, shielding effects, and ionization energy.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Subatomic particles have characteristic mass, charge, and location within the atom. ● Ions are atoms with fewer or more electrons than protons resulting in positive or negative charges. ● Isotopes vary in numbers of neutrons that affect atomic mass but not atomic number. ● Some isotopes produce radioactivity that may change an atomic nucleus and produce a new element. ● Radioactive isotopes have characteristic rates of decay measured in half-lives. ● Radioactive energy is released from the nucleus as alpha particles, beta particles, and gamma rays. ● Nuclear energy produced during controlled radioactive decay is used to generate electricity. ● The horizontal periods of the periodic table arrange atoms by increasing mass and electron number. ● Newly discovered elements may be placed in the periodic table as their properties are characterized. ● Electron configuration determines the chemical properties and bonding characteristics. ● Atoms with paired electrons behave differently from those with unpaired electrons. ● Elements with similar electron configurations are arranged in vertical groups (families) in the periodic table.	● What are the characteristics of subatomic particles? ● How is atomic mass determined? ● How is the average atomic mass of an element determined? ● Why do atoms form ions? ● What is an anion? a cation? ● How is an isotope different from an ion? ● Why do atoms undergo radioactive decay? ● What forms of energy are produced during radioactive decay? ● What is the composition, the penetrating power, and shielding needed for each of these types of energy? ● What is the mass of a given radioactive sample that remains after a given period of time? ● How has the model of the atom changed with new discoveries? ● What are the names of the groups (families) from left to right? ● What are the physical and chemical properties of metals? ● What are the physical and chemical properties of nonmetals and metalloids? ● What is the periodic law and periodicity? ● How are electrons arranged around an atomic nucleus? ● Which of the atom's electrons are involved in chemical bonding? ● Why do atoms gain, lose or share electrons? ● How do unpaired electrons promote the formation of chemical bonds? ● How is the Aufbau Principle and Hund's Rule applied to electron configurations?

● Energetic electrons may move to higher energy levels and then back to the ground state with the release of energy. ● Periodic trends (electronegativity, ionization energy, shielding, oxidation number, and atomic radius) are determined by both atomic number and electron configuration of an atom. ● Periodic trends explain the chemical properties of elements.	● How does the Pauli Exclusion Principle apply to electron configurations? ● What happens when a valence electron is excited and promoted to a higher energy level? How is this information applied in research and medicine? ● What is electronegativity and how does electronegativity of an atom change with period and group (family)? ● What is measured as atomic radius and what is the trend regarding atomic radius found in the periodic table? ● What is ionization energy, what is the trend regarding ionization energy found in the periodic table? ● What is the shielding effect and what is the trend regarding shielding found in the periodic table? ● How is oxidation number related to ion formation? ● What are the oxidation numbers of alkali metals, alkali earth metals, transition metals, halogens, and noble gases?

Standard 5

The student will investigate and understand matter and energy are conserved in chemical reactions.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Chemical formulas represent the numbers and types of atoms in a compound or molecule. b. Compounds and molecules are named for their atoms and the interactions between those atoms. c. Bonds form between atoms by the interaction of valence electrons. d. Molecular geometry predicts both chemical and physical properties of compounds and molecules. e. Balanced chemical equations reflect the law of conservation of matter. f. Types of chemical reactions are classified, and products can be predicted. g. Chemical and physical changes involve the transfer of energy. h. Reaction rates are affected by numerous factors.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The subscripts in a chemical formula represent the relative number of that type of atom in the compound or molecule. ● Chemical formulas represent the manner in which atoms combine and form bonds to complete their valences. ● Most of time, a neutral charge result ● Some atoms exist in nature as diatomic molecules. ● Naming conventions for ionic compounds include naming the cation (and possibly its oxidation state) first followed by the name of the anion. ● Cation names are simply the name of the element followed by "ion" while anion names have suffixes applied to the name of the element. ● Polyatomic ions have names based on charges or oxidation state as well as the types of atoms present. ● Molecules with covalent bonds are most often referred to by a common name. ● Organic molecules are named by the number of carbons present, double or triple bonds present, the shape of the carbon skeleton, and the location and type of functional groups present. ● Electrostatic forces between atoms produce a chemical bond. ● Covalent bonds form when electrons are shared between nonmetal atoms. ● Ionic bonds form when electrons are transferred between nonmetal and metal atoms.	● Why do chemical compounds form? ● How are chemical formulas written? ● What is the Law of Multiple Proportions? ● Are the properties of compounds similar to the properties of the atoms they are made from? ● What are the naturally occurring diatomic molecules? ● How are cations named? ● What are the naming conventions for anions? ● What are the naming conventions for polyatomic anions? ● How are acids named? ● What is the difference between an empirical formula and a molecular formula? ● What is the driving force behind the formation of chemical bonds? ● Why do some atoms form ionic bonds while others form covalent bonds? ● How does ionization energy affect ion formation? ● How do ionic and covalent bonds differ? ● What is the difference between nonpolar and polar covalent bonds? ● What are some examples of ionic compounds? Covalent molecules? Molecules with polar bonds? ● What types of properties do molecules with polar covalent bonds possess?

• Polar covalent bonds form when the electronegativities of the atoms involved are significantly different from one another.
• Lewis dot diagrams show valence electrons involved in forming bonds.
• Three-dimensional models (VSEPR) of the molecule can be drawn based on the orientation of valence electrons.
• The flexibility of the carbon skeleton of organic molecules allows for the formation of complex molecules with unique three-dimensional shapes.
• Chemical reactions involve the formation of unique products from individual reactants.
• All atoms that enter the reaction can be accounted for in the products.
• Coefficients indicate the number of molecules reacting or being produced during a reaction.
• The six major types of chemical reactions include:
  o synthesis
  o decomposition
  o single replacement
  o double replacement
  o combustion
  o neutralization
• Products of chemical reactions can be predicted knowing the type of reaction occurring.
• Redox reactions involve an explanation of the transfer of electrons as a reaction proceeds.
• Enthalpy cannot be measured directly and so changes in enthalpy are monitored as heat lost or absorbed.
• Endothermic reactions require energy and have a positive enthalpy.
• Exothermic reactions release energy and have a negative enthalpy.
• Entropy is a measure of randomness or disorder in a system.
• Systems naturally increase in entropy.
• Reaction rates are affected by.
  o concentration or pressure of reactants
  o phase of the reactants or products
  o temperature
  o activation energy
• presence or absence of catalysts
	• How does a Lewis dot structure predict chemical bonding?
	• What is a VSEPR structure?
	• How are VSEPR structures useful?
	• What are the basic VSEPR shapes?
	• How are unique products of chemical reactions formed?
	• What are the steps involved in balancing chemical equations?
	• Why is it important to always present a balanced equation?
	• What are the key features of a reaction that indicates the type of reaction occurring?
	• What are the products expected with each type of reaction?
	• What is a redox reaction?
	• How is redox reaction balanced?
	• What is enthalpy?
	• What are some examples of endothermic and exothermic reactions?
	• Which reaction type is expected to occur spontaneously?
	• What is entropy? How is entropy related to chemical systems?
	• How is a reversible reaction distinguished from an irreversible reaction?
	• What factors affect the rate of product formation?
	• How is a reaction rate diagram read?
	What factors may shift a system from equilibrium to a new equilibrium?

Standard 6

The student will investigate and understand common molar relationships.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. The *mole* is the fundamental unit used to count atoms. b. Stoichiometry is the calculation of chemical quantities involved in chemical reactions.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● As defined by Avogadro, a mole is 6.023×10^{23} particles. ● This quantity allows for the conversion between mass, volume, and moles of a substance. ● Molar mass is the average atomic mass (in grams) of an element. ● Molar volume is the volume of one mole of any gas at standard temperature and pressure (STP) and is equal to 22.4 L/mol. ● The ratios of atoms within molecules are fixed. ● Atoms combine in whole numbers of quantities to form molecules. ● The mass of the elements in an unknown molecule may be used to determine the chemical formula of the unknown ● Limiting reagents determine the moles of a product that may be formed in a chemical reaction. ● Percent yield is the efficiency of the conversion of the reactants into products.	● What is a mole? ● How many atoms of carbon (oxygen, nitrogen, etc.) does one mole of carbon contain? ● How much does one mole of carbon (oxygen, nitrogen, etc.) weigh? ● What is the molar mass of carbon (oxygen, nitrogen, etc.)? ● How does a mole allow for conversion of number of atoms to mass and volume? ● What is molarity? ● How can chemical formulas be used to determine quantities of reactants and products? ● What is a limiting reagent? ● Given an amount of reactant, how can the amount of product produced be determined?

Standard 7

The student will investigate and understand solutions behave in predictable and quantifiable ways.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Solutions are mixtures with physical properties related to the interactions of their solutes. b. Dissociation of molecules may occur when placed in solution. c. Acids and bases react in solution in characteristic ways.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Temperature changes will increase or decrease solubility of solutes. • Colligative properties are those that are dependent on the solutes present and the extent of dissociation of those solutes. • Boiling point elevation and freezing point depression occur as solute numbers increase. • The extent of dissociation of a substance in solution is related to the types of bonds within the substance. • Ionic compounds dissociate in polar solvents and dissolve. • Nonpolar molecules do not dissociate in polar solvents and will not be dissolved. • Acids and bases dissociate in aqueous solutions to produce hydrogen ion or hydroxide ion. • The pH scale indicates the extent of dissociation of the acid or base. • The definition of acids and bases is described in several ways. • Titrations are conducted to determine the concentration of acids or bases. • pH indicators and probes may be used to determine pH	• How is a solubility chart read? • What are the colligative properties? • How do changes in pressure change a liquid's freezing and boiling point? • How do the numbers of solute particles change the freezing point and boiling point of a pure substance? • What does "like dissolves like" mean? • What are some examples of dilute, concentrated, saturated, and supersaturated solutions? • What is the difference between strong electrolytes, weak electrolytes, and nonelectrolytes in terms of dissociation? • How does dissociation of solutes explain boiling point elevation and freezing point depression? • What is pH measuring? • How is pH related to pOH? • What is hydronium ion? • What is the definition of Arrhenius acid and base? • What is the definition of Bronsted-Lowry acid and base? • How do strong acids or bases differ from weak acids or bases?

Standard 8

The student will investigate and understand phases of matter as described by kinetic molecular theory.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Temperature and pressure determine the phase of a substance. b. The properties of gases are described by the ideal gas law. c. Physical properties are determined by intermolecular forces.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• The kinetic molecular theory explains the properties of gases. • Gas particles have rapid and constant motion and will exert pressure on the walls of their containers. • Equal volumes of gases at the same temperature and pressure have the same number of particles. • Changes in pressure, temperature, and volume will cause changes in the state of a substance. • Energy is absorbed or released as changes in phase take place. • The ideal gas law (PV = nRT) explains the relationship between pressure, volume, number of moles, and temperature of a gas • Boyle's law defines the relationship between pressure and volume of a gas at constant temperature ($P_1V_1 = P_2V_2$) • Charles' law describes the relationship between volume and temperature of a gas at constant pressure ($V_1/T_1 = V_2/T_2$) • The combined gas law is stated as $P_1V_1/T_1 = P_2V_2/T_2$ and illustrates the relationship between pressure, volume, and temperature of a gas • Dalton's law of partial pressures states that the sum of the individual pressures of a gas in a mixture is equal to the total pressure of the mixture ($P_A + P_B + P_C$ + etc.) = P_{total} • Intermolecular forces such as van der Waals forces (London dispersion forces), hydrogen bonds, dipole-dipole attraction determine the state of matter of a substance at a given temperature. • Intermolecular forces are weaker than intramolecular bonding forces. • When the vapor pressure of a liquid is equal to atmospheric pressure, the liquid boils. • Liquids with weak intermolecular attraction are considered volatile and have high vapor pressures with low boiling points.	• Which units indicate pressure? • How are specific amounts of energy absorbed or released during phase changes? • How is a phase diagram interpreted? • What is molar heat of fusion and molar heat of vaporization? • What is specific heat? • What is plasma? • What are the properties of a gas? • Given a set of data about a gas, how are pressure, volume, number of moles, and temperature of that gas determined? • What is the ideal gas law? • What is Boyle's law? • What is Charles' law? • What are the effects of increasing and decreasing temperature on the kinetic energy of particles? • What is the combined gas law? • What is Dalton's law of partial pressures? • What types of interactions may cause molecules to associate with one another? • How do these attractions determine the state of matter of the molecules? • How do volume, temperature, and pressure affect the state of matter? • What is vapor pressure? • What is the relationship between vapor pressure and boiling? • What is the difference between volatile and nonvolatile molecules?

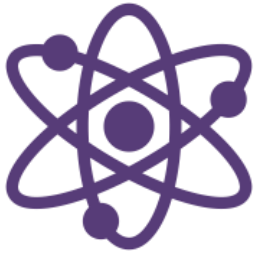
• Liquids with strong intermolecular attraction are nonvolatile and have low vapor pressures and high boiling points. • If energy is applied, intermolecular forces can be broken, and the substance will undergo a phase change from solid to liquid or from liquid to gas	

Standard 9

The student will investigate and understand basic chemical properties related to organic chemistry and biochemistry.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. The unique characteristics of organic molecules are related to carbon chemistry. b. Organic macromolecules found in living organisms form the basis for life.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Carbon forms nonpolar covalent bonds with many atoms including other carbon molecules. ● Carbon skeletons may be straight chains, branching chains, rings, or combination of all of these basic structures. ● Double and triple bonds may form within a carbon skeleton creating unique three-dimensional geometries and chemistries. ● Organic compounds are used as fuels, plastics, pharmaceuticals, and food. ● There are four classes of organic macromolecules that are important for living organisms. ○ Carbohydrates ○ Lipids ○ Proteins ○ Nucleic Acids ● Carbohydrates, proteins, and nucleic acids are polymers of many types of monomers arranged in varying numbers and structures. ● These variations produce a wide variety of molecules in living organisms. ● Biologically important lipids form from basic units but are not linked together to form polymers.	● What characteristics of carbon enable the ability of carbon to form complex and diverse molecules? ● What are some examples of organic molecules? ● How does a double or triple bond change the shape of an organic molecule such as a fatty acid? ● Which organic molecules are most often used as fuels? ● What are some examples of polymers? ● How is a polymer formed? ● What kind of molecule is a plastic? ● What are the functions of molecules classified as carbohydrates? Lipids? Protein? Nucleic acids? ● How do these molecules, made from repeating monomers, form multiple structures, and provide a tremendous variety of functions? ● What are the major components of triglycerides and phospholipids?

High School - Physics



The student will:

- understand the impact of science on human activities with respect to Catholic morality and beliefs.
- incorporate the practices of science and engineering into the study of Chemistry.
- demonstrate an understanding of scientific reasoning, logic, and the nature of science.
- investigate and understand displacement, velocity, and acceleration.
- investigate and understand a force can change an object's position, velocity, and acceleration.
- investigate and understand Newton's Laws of Motion.
- investigate and understand circular motion and universal gravitation.
- investigate and understand energy and work.
- investigate and understand momentum.

Standard 1

The student will understand the impact of science on human activities with respect to Catholic morality and beliefs.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Address the importance of stewardship and the care of creation. b. Discuss ethical considerations in technological advancements, medical technology, and bioethics. c. Discuss the access to and distribution of resources and technology from a solidarity and social justice perspective.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● There are environmental consequences to human activities. ● explore the ethical implication of scientific advancements such as genetic engineering and artificial intelligence. ● discuss the moral obligations to ensure equitable access to resources. ● explore topics like renewable energy, sustainable development, and the impact of energy consumption on marginalized communities. ● discuss implications of physics for human life and dignity, particularly in areas such as medical technology and bioethics ● explore topics through a Catholic lens, examining issues like abortion, euthanasia, and assisted reproductive technologies. ● discuss the Church's teachings on the sanctity of human life and the moral considerations that arise when applying scientific advancements to human beings.	● What are the teachings of the Catholic Church with respect to Physics? ● How does one study and practice physics with the stewardship of the environment in mind?

Standard 2

The student will incorporate the practices of science and engineering into the study of Physics.

Benchmarks Key knowledge and skills we want students to know and be able to do
s. Asking questions and defining problems. t. Developing and using models. u. Planning and conducting investigations. v. Using mathematics and computational thinking. w. Understanding the limitations of measured quantities through the appropriate use of significant figures and error analysis. x. Constructing explanations and designing solutions. y. Engaging in argument from evidence. z. Understanding the use of appropriate technology for gathering and analyzing data and communicating results. aa. Applying known facts and principles to solve new problems or evaluate new situations.

Standard 3

The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science.

Benchmarks Key knowledge and skills we want students to know and be able to do	
e. Scientific investigations are planned and conducted using the scientific method. f. Appropriate technology is used.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Observations are recorded properly. ● Living organisms are treated respectfully and used appropriately. ● Chemicals and equipment are used safely. ● Communication of results involves writing scientifically with the use of scientific literature. ● Alternative scientific explanations and models are recognized and analyzed. ● Scientific hypotheses, theories, and laws are differentiated from non-scientific usage of these terms. ● Mathematical manipulations including SI units, scientific notation, equations, graphing, ratios and proportions, significant figures and dimensional analysis are completed properly. ● Use of appropriate technology will produce meaningful data. ● Data are able to be analyzed and presented in many different forms. ● Models and simulations are valuable additions to or alternatives for some types of bench work.	

Standard 4

The student will investigate and understand displacement, velocity, and acceleration.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. The linear motion of a system can be described by the displacement, velocity, and acceleration of its center of mass.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• Displacement, velocity, and acceleration are all vector quantities. • Displacement is change in position. • Velocity is the rate of change of displacement with time. • Acceleration is the rate of change of velocity with time. • A choice of reference frame determines the direction and magnitude of displacement velocity, and acceleration. • Kinematic equations only apply to constant acceleration situations.	• How can the motion of an object be predicted and explained? • How can models be used to understand and describe motion?

Standard 5

The student will investigate and understand a force can change an object's position, velocity, and acceleration.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. The internal structure of a system determines many properties of the system. b. A gravitational field is caused by an object with mass. c. Contact forces result from the interaction of one object touching another.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
• A system is an object or a collection of objects. • The student can create representations and models of natural or manufactured phenomena and systems. • For all systems under all circumstances, energy, charge, linear momentum, and angular momentum are conserved. • For an isolated or a closed system, conserved quantities are constant. • An open system is one that exchanges any conserved quantity with its surroundings. • Forces can be classified as at a distance force or contact force. • Earth's gravitational field causes an object to have weight. • Gravity is one of the four fundamental forces in nature. • Friction is the force that resists the motion of one object moving relative to another object. • Friction depends on the surfaces in contact and the normal force. • Tension is a pulling force transmitted by a string, rope, chain, etc. • The normal force is a support force exerted upon an object perpendicular to the surface. • The spring force is the force exerted by a compressed or stretched spring upon an object attached to it.	• How can a system be modeled or represented? • How does the reference frame influence the system? • How should a system be defined in order to solve a problem or answer a question? • How do objects respond when placed in a gravitational field? • Why is the acceleration due to gravity constant on Earth's surface? • How strong is gravity compared to the other fundamental forces? • What is the difference between static and kinetic friction? • How does friction influence motion in everyday life? • How can friction be helpful? • In a system with multiple forces present, how can the net force and the acceleration be calculated? • How can the spring constant be calculated? • When is the normal force equal to the gravitational force?

Standard 6

The student will investigate and understand Newton's Laws of Motion.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Newton's Laws of Motion can be applied to any system with forces acting upon it.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● Forces can be represented with vectors. ● Forces have magnitude and direction. ● Forces can be described in terms of components. ● Forces can be detected by their influence on an object's motion. ● Objects at rest do not necessarily have zero forces acting on them. ● An object's acceleration is always in the same direction as the net force acting on the object. ● Free body diagrams are used to show the forces on an object. ● The acceleration of an object is directly proportional to the net force acting on it. ● Inertia is a property of matter. ● If one object exerts a force on a second object, the second object always exerts a force of equal magnitude on the first object in the opposite direction.	

Standard 7

The student will investigate and understand circular motion and universal gravitation.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. Newton's Law of Universal Gravitation can be used to calculate the gravitational force that two objects exert on each other. b. A force is required to keep an object moving in a circle.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The gravitational force is always attractive. ● Close to the earth's surface, g is approximately constant. ● A gravitational field is caused by an object with mass. ● On Earth, the gravitational force on an object is called weight. ● An object's circular motion can be described using velocity and acceleration. ● A centripetal force is needed to keep an object moving in a curved or circular path. ● An object will move tangent to the circle if the centripetal force is removed. ● Kepler's Laws of Planetary Motion can be used to describe the motion of planets and moons.	● How does the mass of an object affect its gravitational field? ● How does the distance between objects affect the gravitational force? ● How can g be calculated? ● How does an object's weight change if it is brought to a different planet? ● In what direction is the velocity vector? ● What variables affect an object's velocity? ● In what direction is the acceleration vector? ● In what direction is the force vector? ● How can the velocity of an object moving in a circle be calculated? ● How can the orbital speed of planets be calculated?

Standard 8

The student will investigate and understand energy and work.

Benchmarks Key knowledge and skills we want students to know and be able to do
a. A force exerted on an object can change the object's kinetic and/or potential energy. b. Interactions with other objects or systems can change the total energy of a system. c. In a closed system, energy is conserved.

Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The change in the kinetic energy of an object depends on the force exerted on the object and on the displacement of the object during the interval that the force is exerted. ● Only the component of the net force exerted on an object parallel or antiparallel to the displacement of the object will increase (parallel) or decrease (antiparallel) the kinetic energy of the object. ● The magnitude of the change in the kinetic energy is the product of the magnitude of the displacement and of the magnitude of the component of force parallel or antiparallel to the displacement. ● The kinetic energy of a rigid system may be translational, rotational, or a combination of both. ● Perpendicular forces can change an object's motion without changing its kinetic energy. ● Work is a transfer of energy. ● A single object can only have kinetic energy since potential energy requires an interaction between two or more objects. ● The rate at which work is done is power. ● The total energy of a system includes its kinetic energy, potential energy, and internal energy. ● Make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass. ● Mechanical energy is the sum of kinetic and potential energy. ● Changes in a system's potential energy can result in changes to the system's kinetic energy.	● How is an object's kinetic energy calculated? ● What factors can change an object's kinetic energy? ● How is an object's potential energy calculated? ● What are the types of potential energy that an object may have? ● How can work be calculated? ● When is work done on an object? ● How can work be found from a graph of force vs. displacement? ● How is power calculated? ● What are the types of potential energy a system can have? ● How will the energy of a system change due to friction within the system? ● What effect does friction have on mechanical energy?

Standard 9

The student will investigate and understand momentum.

Benchmarks Key knowledge and skills we want students to know and be able to do	
a. A force exerted on an object can change the momentum of the object. b. The linear momentum of a system is conserved.	
Essential Knowledge Key facts, concepts, and ideas needed to successfully meet benchmarks	**Essential Questions** Questions to guide student inquiry and focus instruction to uncover big ideas
● The change in momentum of an object is a vector in the direction of the net force exerted on the object. ● The change in momentum of an object occurs over a time interval. ● Analyze data to determine the change in momentum of an object from the average force exerted on it and the time interval over which the force is exerted. ● In a collision between objects, linear momentum is conserved. ● Open systems exchange momentum with their surroundings. ● In an elastic collision, kinetic energy is also conserved. ● In an inelastic collision, kinetic energy is not conserved.	● How is momentum calculated? ● What does momentum depend on? ● What is impulse? ● How does change in momentum relate to time? ● How can momentum be calculated from a graph of force vs. time? ● How is momentum before and after a collision calculated? ● What is the difference between an inelastic and an elastic collision? ● What happens to the kinetic energy in an inelastic collision? ● How can a collision be classified as elastic or inelastic? ● How can the Law of Conservation of Momentum be used to solve for the final velocity of an object after a collision?