Science Curriculum

Sixth – Eighth Grades

VISION OF STUDENT

By the end of Eighth Grade, students will understand the steps of the Scientific Method and how to apply them to scientific experimentation. They will use scientific tools and measurement through a variety of laboratory experiences. Finally, students will know and apply scientific terminology and concepts to understand their roles and impacts in God's world.

CROSS-CUTTING CONCEPTS:

The following ideas are the foundation of this curriculum:

1. **Systems and System Models** – Systems may interact with other systems and thus be part of a larger more complex system. These systems and their relationships may be demonstrated and explained through the use of models.
2. **Structure and Function** – Structures and systems can be visualized and modeled to describe how their function depends on shape, composition, and relationships among the parts.
3. **Cause and Effect** – Cause and effect relationships may be used to predict phenomena in natural or designed systems, with the realization that a given phenomenon may have more than one cause.
4. **Energy and Matter** – The Laws of Conservation of Energy and Matter require the cycling of energy and/or matter within any system.
5. **Stability and Change** – Explanations of stability and change in systems can be constructed by examining the changes over time and forces at different scales.
6. **Patterns** – Patterns can provide information about rates of change and other numerical relationships about systems.
7. **Scale, Proportion and Quantity** – Phenomena can be observed at various scales using models to study systems that are too large or too small. Scientific relationships can be represented through the use of algebraic equations and proportions.
8. **Influence of Engineering, Technology, and Science on Society and the Natural World** – All human activity draws on natural resources and has positive and negative consequences on systems in the short and long term. The uses of technologies are driven by people's needs, desires and values.

Standard 1. Investigation and Inquiry Process with Catholic values.

These concepts are intended to be applied throughout the course of study of Standard 2 (Life), Standard 3 (Physical), and Standard 4 (Earth) at the appropriate times.

Basic Skills and Catholic Values

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Use the metric system as the means for scientific measurement.	• Identify the major units used to measure length, volume, and mass. • Know which units are appropriate for the size of an object, including using scientific notation when appropriate. • Use the factor-label method to convert metric units.	
2. Identify and use scientific tools.	• Be able to safely use a light microscope, a balance scale, a ruler, a graduated cylinder, etc.	
3. Use the scientific method.	• Design, develop, and report on a science fair experiment using the scientific method. • Define an engineering problem and design and report on a solution. (See Applications of Engineering Design). • Write a formal lab report. (See Appendix)	
4. Demonstrate stewardship of the Earth.	• Recognize that God calls us to care for His creation through conservation awareness and activities.	
5. Apply Catholic values towards advancements in science, medicine, and technology.	• Ask the question, "Just because we CAN do something, does that fit in God's plan?"	

6. Apply Catholic teachings about the origin of life in a discussion of the theory of evolution.	• Know that God is the source of all that exists and the processes that have changed the Earth and life on it.	
7. Use the internet as research tool.	• Research the question being asked in a science fair project.	
8. Use the computer as a presentation tool.	• Present a topic (such as information regarding a human body system) with PowerPoint.	

Application of Engineering Design, Technology, and Society

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Develop ideas for solving an environmental problem, keeping in mind short and long-term consequences.	• Compare sand blasting, chemical solvents, or high heat as methods of graffiti removal.	• Communicate information about a proposed solution to a problem, including relevant scientific principles, how the design was developed, how it meets the criteria and constraints of the problem, and how it reduces the potential for negative consequences for society and the natural environment.
2. Develop a better design by combining characteristics of different solutions to arrive at a design that better meets societal needs.	• Develop a design for a highly energy efficient automobile by combining ideas from different car ads. (Qualitative only at this level.) • Test different bridge designs to determine which will hold the most weight. • Refine the design of a building to withstand an earthquake or the design of a water filtration system.	• Use a computer simulation to test the effectiveness of a design under different operating conditions, or test what would happen if parameters of the model were changed, noting how the simulation may be limited in accurately modeling the real world.
3. Explain how advances in engineering	• For example, discoveries in physics lead	

have resulted in new tools that enable new scientific discoveries, which then lead to the development of entire industries.	to the development of computers. • Explore how discoveries in genetics have led to genetically modified crops.	
4. Evaluate how a technology has changed over time, resulting in either positive or negative impacts on society.	• Examine the use of fossil fuels to reduce the needs to decimate forests for heating and cooking but have been found to change the climate and atmosphere. • Select a device (such as a car or telephone) and discuss its modifications over time.	
5. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	• Research systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem, select a process and apply it to a design.	

Standard 2: Life Science

Cells

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. List the basic molecules of life.	• Give examples of a carbohydrate, lipid, protein, and nucleic acid.	
2. Recognize cells as the basic unit of all living things and their processes and that all cells come from other cells. Recognize the differences between cells, in relation to the two domains.	• List the three tenets of the Cell Theory. • Identify cells as being prokaryotic or eukaryotic, having a cell wall or cell membrane as an outer covering, containing chloroplasts or not.	

3. Identify the function of various cell organelles. Identify different processes for transporting materials in and out of cells to obtain food and water and dispose of waste. Distinguish between mitosis and meiosis cell division processes.	• Compare the function of various cell organelles to human organs. • Compare the processes of diffusion, osmosis and active transport and their uses. • Sequence events of mitosis. • Make models of phases of mitosis. • Recognize the importance of mitosis as the means by which multicellular organisms grow.	
4. Compare the processes of photosynthesis and respiration. Realize that all cells undergo the process of cellular respiration.	• Construct a cyclical diagram using the equations for each process. • Conduct the Elodea (Anacharis as sold locally) experiment with bromothymol blue to understand that plants do both photosynthesis and respiration.	• Investigate and present evidence that plants continue to grow throughout their life through the production of new plant matter via photosynthesis.
5. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.	• Students present evidence based on their investigation.	
6. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell.	• Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell.	
7. Use argument supported by evidence for how the body is a system of interacting	• Assessment Boundary: Assessment does not include the mechanism of one body	

subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.]	system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.	

Characteristics and Classification of Living Things

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. List the characteristics of living things.	• Identify how any living thing demonstrates these characteristics.	
2. Recognize the role of classification as a way to organize the wide variety of living things.	• Construct a simple branching diagram to classify organisms through shared characteristics.	
3. Realize that classifications change as we discover more about living things.		
4. Apply the methodology of classification.	• Students will create a simple dichotomous key.	
5. Identify the eight levels of classification for ordering living things.	• List the levels of classification in order from largest to smallest. (Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species)	

Heredity, Genetics & Evolution

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Recognize that traits are inherited from parent to offspring. Distinguish between the terms for inheritance. (Dominant vs. recessive, allele vs. trait, genotype vs. phenotype, types of dominance, expression of traits)	• Use a Punnett square or pedigree to show the inheritance of traits. • Use a Punnett square to predict probabilities of how traits are expressed. Dominant vs. recessive, allele vs. trait, genotype vs. phenotype, types of dominance, expression of traits.	
2. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]	• Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.	
3. Recognize the difference between asexual and sexual reproduction.	• Model the processes of mitosis and meiosis to using long and short pieces of yarn to demonstrate the resulting cells being identical to the parent or containing	

	half the number of chromosomes.	
4. Identify contributions of key scientists in developing our understanding of heredity.	• Study the experiments of Mendel and the observations of Darwin.	
5. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.	• Compare natural selection, selective breeding, and genetically modified organisms. Cite fossil records as evidence of changes in populations over time. • Recognize how mutations lead to inherited traits which result in harmful, beneficial, or neutral traits. • Use mathematical models to explain how natural selection results in changes within species over many generations.	
6. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]	• Students present oral reports on their explanations.	
7. Relate the age of the Earth to the appearance of life on Earth through evidence of geological layers and fossil records.	• Have students construct a geologic time line to scale, using the context of a 1000 page book. If page one is when the Earth was formed, on what pages do other events happen, such as appearance of dinosaurs or man?	
8. Comprehend that the extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.	• Explore possible explanations for the extinction of dinosaurs. • Identify animal behaviors which lead to successful reproduction.	
9. Describe the basic structure of DNA and	• Give the students the base sequence from	

its role in the genetic code.	one DNA strand. Ask them to determine the base sequence of the complementary strand. Watson/Crick/ Rosalind Franklin.	

Bacteria, Protist, and Fungi Kingdoms

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Identify the differences and similarities between bacteria, protists, and fungi. Identify different types of organisms from each of these kingdoms.	• Size comparison, prokaryotes vs. eukaryotes, movement, cell structure. • Compile a list of organisms for each kingdom.	
2. Identify how members of these kingdoms exhibit the characteristics of living things. Explain why a virus is non-living.	• Identify how bacteria, protists, and fungi use energy and reproduce. • Use the characteristics of living things to compare viruses and bacteria to realize that viruses do not exhibit all characteristics.	
3. Recognize methods of combating pathogenic bacteria, viruses, and fungi. Recognize positive and negative roles in our world of bacteria, viruses, and fungi.	• Identify common illnesses that are combated with antibiotics or vaccines. • Create a poster displaying these roles.	

Plant Kingdom

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Differentiate between various members of the plant kingdom. Identify more complex structures of plants.	• Create a branching diagram to group plants into non-vascular and the different types of vascular plants. • Label a diagram of a non - vascular plant and vascular plant which includes vascular tissues.	
2. Identify different methods of reproduction within the plant kingdom.	• Gametophyte, sporophyte, seeds, cones, fruit & flowers, monocot vs. dicot.	

Animal Kingdom

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Differentiate the ways that organisms sense and respond to their environment and communicate with each other.	• Distinguish between the varying complexities of nervous systems within the animal kingdom. • Explore the complexity of the human nervous system by explaining how information from external stimuli is transmitted to, processed by and stored in the brain.	

2. Describe how the major groups of invertebrates exhibit the six characteristics of living things. Identify members of the major groups of invertebrates. Recognize the diversity and importance of each group of invertebrates.	• Compare and contrast the way different invertebrates move, reproduce and respond to the environment. • Create or use a dichotomous key to distinguish between different types of worms. • Identify the groups of arthropods (insects, arachnids, crustaceans) and the roles in the environment.	
3. Identify the five classes of vertebrates and their differences in regards to body covering, reproduction, and obtaining oxygen.	• Conduct a dissection lab (either virtual or actual) to compare physical structures. • Recognize the three characteristics all vertebrates share and that those traits can appear as part of embryological development.	
4. Determine adaptations that allow organisms to survive in different environments.	• Pose questions like "At the top of the Rockies, what types of organisms would you expect to find and why?" • Differentiate the ways that the five classes of vertebrates sense and respond to their environment. • Compare how two populations of the same species in different environments have evolved to be separate species.	
5. Recognize the complexity of the human body, by identifying the function and parts of all body systems, and how they function together. ❖ Omit if covered in a separate health class.	• Construct an outline of students' bodies and have them build 3D models of body systems.	• Construct models and representations of body systems to demonstrate how multiple interacting subsystems and structures work together to accomplish specific functions. [Clarification Statement: Representations are specific to the interactions of the systems and focus on the following systems: excretory, digestive, respiratory, and nervous systems.] [Assessment Boundary: The focus is on the interaction of subsystems

		within the system, not the mechanism of each body system itself.]

Biomes and Ecosystems

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Describe how energy flows in ecosystems. Differentiate between a biome, an ecosystem, a habitat, and a niche.	• Construct food chains and food webs. • Develop an explanation for the role of photosynthesis in the cycling of matter and flow of energy. • Identify various biomes, ecosystems, habitats and niches and the relationship between them.	
2. Recognize the importance of group interactions to the survival of a population.	• Identify how interaction within a group benefits an individual organism.	
3. Distinguish the biotic and abiotic features in ecosystems.	• Create a list of biotic and abiotic features in a particular ecosystem.	
4. Evaluate the effect of human impacts on ecosystems and the biotic and abiotic features within them.	• Propose and analyze possible solutions to problems caused by human impact on the environment. • Evaluate the impact of human population and rates of consumption increases on Earth's systems.	
5. Evaluate the effect of other living things on biotic and abiotic features within ecosystems.	• Identify impacts living things have on the Earth, such as the role of tree roots in soil formation. • Explore predator-prey, competitive and symbiotic relationships.	

6. Relate biodiversity to the availability of resources within an ecosystem.	• Describe the effect on an ecosystem when the population of one species is increased or decreased.	
7. Explore the possible impacts of global climate change on the types and variety of species.	• Explain how population changes could be caused by climate change.	
8. Evaluate technologies that utilize renewable energy resources.	• Examine solar, wind, hydroelectric, and nuclear technologies based on cost, benefit, sustainability, safety, and environmental impacts.	

Standard 3: Physical Science

Composition and Properties of Matter

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Distinguish between atoms, molecules, elements, compounds, and mixtures.	• Draw and label the parts of an atom. • Model various compounds of H and O. • Differentiate between the types of mixtures.	
2. Recognize that pure substances can be distinguished between one another based on characteristic properties.	• Realize that properties of density, reactivity, flammability, phase, solubility, and melting/boiling point can be used to distinguish substances.	
3. Identify a change as chemical or physical. Name the states of matter and their properties.	• Use the process of baking a cake to identify various chemical or physical changes. Explain how the addition or subtraction of energy changes the state matter.	

4. Differentiate between the atomic number and atomic mass of an atom and their relationship to the numbers of protons, neutrons, and electrons. Analyze the relationship of the elements in rows and columns of the Periodic Table.	• Find the number of protons, neutrons, electrons in an atom using the information from a Periodic Table. • Arrange atomic models in rows and columns of Periodic Table.	
5. Explain the difference between a coefficient and a subscript in a molecular formula. Relate how the addition and subtraction of electrons form ions.	• Discriminate the number and types of atoms in a molecular formula. • Determine the charge of the ion formed by the addition or subtraction electrons.	
6. Define terms related to radioactivity, such as isotope or the types of radioactive particles. Identify the types of nuclear reactions. Recognize the significance of the half-life of a radioactive sample.	• Relate how the addition and subtraction of neutrons form isotopes. • Distinguish between fission and fusion. • Simulate half-life scenario using a box of pennies that can be flipped.	

Interactions of Matter

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Identify the types and properties of different chemical bonds. Recognize the four types of chemical reactions (synthesis, decomposition, single & double replacement).	• Explain the role of electrons in forming ionic, covalent or metallic bonds. • Categorize a chemical reaction based on the equation.	
2. Apply the Law of Conservation of Matter.	• Balance simple chemical equations.	

3. Describe the role of energy in chemical reactions. Discover the effect of temperature, concentration, surface area and enzymes on the rate of reaction.	• Give examples of endothermic and exothermic reactions. • Use a model to represent the movement of matter and energy in the carbon cycle. • Conduct chemical reactions in which temperature or concentration of reactants is changed.	
4. Compare the properties of acids and bases.	• Use indicators to determine whether a chemical is an acid or base. Name the products of an acid/base reaction.	
5. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.]	• Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.	
6. 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. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could	• Students develop model and present the model to the class.	

include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]		

Forces and Motion

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Define motion. Differentiate between speed, average speed, velocity and acceleration plus momentum.	• Describe motion of objects using frames of reference of stationary and moving observers using appropriate units of measure. • Use formulas for each to calculate these quantities and graph results over time. Also, explain how velocity and acceleration relate to speed and direction.	
2. Identify the possible forces which can act upon an object (i.e., friction, gravity). Recognize unstable systems will seek stability, even without energy input.	• Relate the motion of objects of various masses to the sum of the forces acting on it. • Apply the effect of forces on changing the shape and orientation of an object. • Demonstrate concept through observing sand in an hourglass.	
3. 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.	• Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.	

[Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.]		
4. Describe Newton's Laws of Motion.	• Apply the laws to a situation, such as what happens when you jump off of a boat, identifying the stable and unstable conditions within it.	
5. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.]	• Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.	
6. Distinguish between the mass and weight of an object.	• Calculate the weight of an object.	

Energy and Work

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Identify forms of energy in our world. Foster an awareness of where energy comes from in our everyday lives.	• Classify energy sources as chemical, thermal, mechanical, etc. • Apply energy awareness to calorie intake.	
2. Explore energy conversion and its	• Identify devices which convert one form	

relationship to the law of conservation of energy.	of energy to another. • Apply the transfer of light, chemical, and thermal energy to ecosystems, recognizing the total amount of energy does not change.	
3. Explain the difference between kinetic and potential energy.	• Analyze situations for the presence of kinetic and potential energy. • Calculate KE and PE, recognizing that velocity has a greater impact on an object's KE.	
4. Recognize the role of heat and its relationship to efficiency.	• Describe how much energy is converted and then lost to heat in any system. • Design a device to maximize or minimize heat transfer.	
5. Explain how energy is transferred through conduction, convection, and induction.	• Diagram how energy is transferred in these ways.	
6. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.]	• Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.	
7. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]	• Students are able to interpret their data for other students.	

8. Relate work done to change of energy in a system. Define work as the product between force and distance. Recognize that power is the rate at which work is done.	• Recognize that work can equal zero in spite of energy change. • Calculate work done in climbing stairs at different rates, recognizing the work is the same. • Calculate power done is climbing stairs and compare it to the power in an electrical appliance.	
9. Identify the six simple machines which make work easier.	• Explain how the machine makes work easier by changing the force and calculate the mechanical advantage. • Design ways to make machines more efficient, such as through the use of lubricants to reduce friction.	
10. Identify the relationship between electricity and magnetism and factors that affect their strength. Demonstrate that some forces act at a distance through fields. Recognize the effect of the Law of Electricity and of magnetic poles.	• Explore this relationship with experiments with electromagnets or a dynamo. • Apply distance to the effect of gravitational, electric and magnetic fields in a non-computational manner. • Use magnets to show that like charges/poles repel, opposites attract.	

Waves

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Define a wave as a means of energy transmission. Identify the three characteristics of waves. Distinguish the differences between mechanical and electromagnetic waves.	• Demonstrate waves with slinkies or ropes. • Demonstrate the relationships between wavelength, amplitude and frequency by using formulas. • Compare and contrast the characteristics	

	of these waves.	
2. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.]	• Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.	
3. Identify the four basic wave interactions.	• Conduct lab experiments with reflection, refraction, diffraction and interference of waves with light and sound.	
4. Recognize the relationship between frequency and amplitude to loudness and pitch of sound waves. Recognize the relationship between frequency and amplitude to brightness and color of light waves.	• Compare different diagrams of waves to identify which would be louder/softer or higher/lower pitch. • (Similar activity to sound wave assessment).	
5. Describe the types of waves in the electromagnetic spectrum. Explain the application of waves in common communication designs.	• List the waves of the electromagnetic spectrum in order from longest wavelength to shortest and relate the amounts of energy contained in each. • Apply to the function of radios, remote controls, cell phones, or Bluetooth.	
6. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.]	• Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.	
7. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information	• Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.	

than analog signals. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.]		

Standard 4: Earth and Space Science

Earth Science

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Identify and define the four basic spheres of the Earth and its composition. Describe the cycles associated with each sphere.	• Classify objects into the biosphere, hydrosphere, atmosphere, and geosphere. Recognize layers of the Earth. • Identify, correlate and connect the water cycle, rock cycle, carbon cycle and nitrogen cycle.	
2. Differentiate between rocks and minerals.	• Identify the characteristics and/or composition of each.	
3. Distinguish between renewable and non-renewable natural resources.	• Describe methods of conservation of resources. • Explain the location of renewable and non-renewable resources as the result of past and current geological processes.	
4. Relate weathering, erosion and deposition	• Construct a diagram to illustrate soil	

to soil composition and formation. Recognize the relationship between types of weathering and erosion.	layers. • Cite examples of mechanical and chemical weathering and erosion and describe how they have shaped the surface of the Earth.	
5. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.]	• Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.	
6. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.]	• Assessment Boundary: Assessment does not include the identification and naming of minerals.	
7. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result	• Students are able to provide evidence for their explanation.	

of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]		
8. Summarize the theory of plate tectonics.	• Cite evidence to support the theory, such as the fossil record as evidence that South America and Africa were connected as part of Pangaea. • Recognize that the geosphere and biosphere co-evolved over time.	
9. Relate the location and causes of earthquakes and volcanoes using the theory of plate tectonics. Identify the three types of volcanoes and their characteristics.	• Relate the features of New Mexico's geology to plate tectonic forces that caused them, including earthquakes and volcanoes. • Demonstrate the each type of volcano through model or drawing.	
10. Locate the various zones in the ocean. Describe the effect of water currents on climate.	• Identify zones of the water column and zones based on topography (intertidal, near shore, and open ocean) and types of marine life in each zone. • Explain the differences in climate caused by the Gulf Stream.	
11. Explain the factors that affect weather and	• Describe the role of the Coriolis affect.	

climate. Recognize that differences in pressure, heat, air movement, and humidity result in changes in weather. Locate and describe the layers of the atmosphere.	• Use probability to analyze data and forecasts to identify patterns and variations in weather reports. • Apply these concepts to explain the occurrence of storms such as tornadoes or hurricanes. • Predict the likelihood of similar future events. • Construct a graph of the layers of the atmosphere which relates the average temperature to the altitude. • Explain the role of greenhouse gases in the atmosphere in maintaining a habitable temperature on Earth.	
12. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]	• Students create a PowerPoint presentation based on their findings.	
13. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the	• Students complete their method and are able to describe the scientific principals applied.	

design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]		
14. Relate the tilt of the Earth on its axis to the cause of the change of seasons.	• Use a flashlight and globe to explain why we have seasons.	

Astronomy

Critical for Mastery in Grade 6-7-8

LEARNING OUTCOMES (What students will be able to do, know, understand and value)	**SAMPLE ASSESSMENTS/STRATEGIES** (What evidence will demonstrate that students have achieved the Learning Outcome)	**BEST PRACTICES**
1. Distinguish between the types of movement of planets.	• Relate rotation and revolution today and year for any planet.	
2. Recognize the hierarchy and magnitude of the universe. Recognize the composition, structure, and formation of the solar system. List the bodies in our solar system in order of their distance from the Sun.	• Identify types of galaxies and celestial bodies. Model a scaled size of the solar system using astronomical units. • Apply gravitational interactions to objects in our solar system. • Use information about the expansion and scale of the universe to support the Big Bang theory. • Explain how the planets and moons within the solar system formed.	

	• View "Pluto Files" and analyze the reasoning behind the reclassification of Pluto.	
3. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Emphasis is on gravity as the force that holds together the solar system and Milky Way and controls orbital motions within them.]	• Students develop the model and can describe the role of gravity in the solar system.	
4. Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.]	• Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.	
5. Explain the interactions of the Earth, its moon, and the Sun.	• Describe day/night cycles, eclipses, tides, and the phases of the moon.	
6. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]	• Students area able to explain their model to the class.	
7. Identify types of stars and their characteristics. Describe the life cycle of stars.	• Describe a star based on its location on the Hertzprung-Russell diagram. • Determine a star's final stage based on its original mass.	

Resources:

Local:

1. **Sandia Labs –** kits are available for a variety of physical science units which provide all needed materials. Contact www.sandia.gov/clim/ASK/crosslink.html.

2. **Nuclear Museum** – has an excellent workshop for teachers on nuclear science. Can check out Geiger counters.

3. **La Luz Academy –** outreach program.

4. **Mr. Dan Kettleborough –** husband of science teacher, Judie Kettleborough, at OLA has an extensive insect collection and is a degreed entomologist. He is willing to bring preserved specimens to discuss and share.

5. **NMSTA –** sign up for the NM Science Teachers' Association to receive information about local teacher workshops, many of which are free.

Online:

1. **ck12.org** – open source books online site which offers FREE flex books, teacher's editions, workbooks. Textbooks are available at middle and high school levels.

2. **stemed.unm.edu** – the information for science fair competition. All rules and forms are provided here. Karen Kinsman is the current director of the Engineering & Research Challenge (aka Regional Science Fair).

3. **education.nmsu.edu/sc2/** - online information in addition to workshops for teachers. There are two 4 day workshops in Las Cruces which are available at no cost to the teacher, but housing will need to be paid.

4. **sciencebuddies.org** – good source of science fair topic ideas, with a survey to assist students in determining what areas interest them. Many topics include procedures and suggestions for variations.

5. **www.nextgnscience.org -** Next Generation Science Standards, April 2103

Technology:

1. **PASCO Spark Science Learning System** – available through www.pasco.com. SPARK Science Learning System is an all-in-one mobile device that integrates the power of probeware with inquiry-based content and assessment. It has a large, full-color display, finger-touch navigation and completely intuitive data collection and analysis capabilities. Students can collect data using the probes which will then be graphed for interpretation.