Archdiocese of Omaha
Catholic Schools

K-12 Science Curriculum Standards

August 2016

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Introduction

Purpose of this curriculum:

The purpose of this guide is to assist administrators and teachers of the Archdiocese of Omaha in teaching science in the Archdiocesan Catholic Schools. This guide contains clear expectations for Science Education Standards based on the Next Generation Science Standards as they relate to each Program Standard. It is intended that this material be used in the development of local science education curriculum plans and for the training of teachers of science education.

Administrators will use this guide to assist teachers in applying the desired Science Education Standards to the specific grade levels.

Teachers will use the guide as the basis for planning their lessons for the year. Use of this curriculum will assist students in attaining the Standards for which all are accountable. Teachers are required to spend 80% of their time teaching strictly from the guide with 20% of their time teaching concepts that enhance the curriculum.

Archdiocese of Omaha Catholic Schools
Mission Statement

The mission of the Catholic Schools in the Archdiocese of Omaha, Nebraska, in cooperation with the parents, is an extension of the four-fold educational mission of the Catholic Church:

- **To proclaim the message of faith and morals**
- **To foster community**
- **To encourage worship and prayer**
- **To motivate to serve others**

Each school is to foster in students a personal relationship with Jesus Christ educating them to become academically proficient and responsible, community-minded adults who will be active and loyal members of their Church and their country.

Archdiocese of Omaha Catholic Schools
Exit Standards

All graduates of Catholic Schools in the Archdiocese of Omaha demonstrate:

- Knowledge of Catholic Church teachings of faith, morals and virtue
- Knowledge of core disciplines and fine arts
- Higher-order thinking skills
- Effective communication skills
- Effective social interaction skills
- Independent learning skills
- Life-long learning with the ability to access and utilize resources
- Knowledge of practices essential to:
  Christ-centered families
  Full participation in parish community life
  Sound health in mind, body and spirit
  Responsible stewardship
  Mature, responsible, and sensible use of technology
  Effective citizenship.

Science Program Mission Statement

Our mission is for all students to apply their understanding of science to become responsible stewards in God's ever- changing world.

Science Program Standards

Program Standard #1: INQUIRY

Program Standard #2: CONNECTIONS

Program Standard #3: INFLUENCE

Science Essential Standards

Standard #1: INQUIRY

Grades K-2: Define problems, ask questions, make predictions, and share discoveries

Grades 3-5: Plan and conduct simple investigations and discuss results

Grades 6-8: Design and conduct appropriate investigations in order to find valid solutions

Grades 9-12: Design and conduct complex investigations using multiple variables utilizing technology to evaluate and communicate results

Standard #2: CONNECTIONS

Grades K-2: Observe, identify, and explore relationships among groups

Grades 3-5: Connect interdisciplinary concepts through the use of critical thinking skills

Grades 6-8: Analyze relationships within and between systems and disciplines using critical thinking skills

Grades 9-12: Evaluate relationships within and between systems and disciplines using critical thinking skills

Standard #3: INFLUENCE

Grades K-2: Recognize how a choice can have an impact on self and surrounding community

Grades 3-5: Research the impact of science on self, surrounding community and environment

Grades 6-8: Investigate and evaluate the impact of science on personal and social decisions

Grades 9-12: Evaluate and predict long-term effects of science, technology, and engineering on humanity on our environment

Primary Grades K-2

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Primary Grades K-2
Science Essential Standards

Standard #1: INQUIRY

Define problems, ask questions, make predictions, and share discoveries

Standard #2: CONNECTIONS

Observe, identify, and explore relationships among groups

Standard #3: INFLUENCE

Recognize how a choice can have an impact on self and surrounding community

Directions for Use of Content Standards

The grade level Content Standards are designed to accompany the Essential Standards. Faculty discussion will need to take place to ensure consistency in teaching. The administrator should reproduce the Content Standards and distribute them to all the teachers.

The format for the Content Standards is as follows:

1. Blank box to record date of instruction of content standards or to use as a check-off to indicate that instruction of standards occurred
2. Numeric system that identifies the specific standard statement
3. Standard Strand
4. Next Generation Science Standard Reference Number **(NGSS)**
5. Program Standard Reference: Inquiry (Q), Connection (C), Influence (I)

Teachers will use this guide as the basis for planning their lessons for the year. Use of the guide will assist students in attaining the Standards for which all are accountable. Teachers are required to spend 80% of their time teaching strictly from the curriculum guide with the remaining 20% of their time teaching concepts that enhance the curriculum.

Program Standards
"**Q**" stands for **Inquiry**; "**C**" stands for **Connections (**NGSS Cross-cutting concepts);
"**I**" stands for **Influence**

Within each Content Standard Strand, the Next Generation Science Standards (NGSS) equivalence is given in parentheses (e.g., NGSS-3-LS1)
Visit www.nextgenscience.org for more information about these standards.

Clarification statements supply examples or additional clarification to the performance expectations.
Assessment boundary statements *specify the limits to large scale assessment.*

Abilities to do Scientific Inquiry (NDE SC2 1.1a-g)
Science Process Skills for Integrating Inquiry into the Content Areas
The following scientific process skills will be ***integrated throughout the content areas*** *for grades K-2. These skills should be mastered at the appropriate level by the end of second grade.*

	Inquiry K.1a	**Observe investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Conduct Simple Investigations ○ Select and use simple tools appropriately ○ Describe objects, organisms, or events using pictures, words, and numbers ○ Collect and record observations ○ Use drawings and words to describe and share observations with others ○ Use appropriate mathematics in all aspects of science inquiry			
✓	**Grade Level**	Content Standard Strand	**Program Standards**		
	Kinder-garten	**Physical Science**	**Q**	**C**	**I**
	K.2 PS	**Motion and Stability: Forces and Interactions (NGSS K-PS2)**			
	K.2a	**Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (NGSS K-PS2-1)** ● Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other. ● *Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*	Q	C	I

	K.2b	**Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. (NGSS K-PS2-2)** ● Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn. ● *Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*	Q	C	I
	K.3 PS	**Energy (NGSS K-PS3)**			
	K.3a	**Make observations to determine the effect of sunlight on Earth's surface. (NGSS K-PS3-1)** ● Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water. ● *Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*	Q	C	I
	K.3b	**Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area. (NGSS K-PS3-2)** ● Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.	Q	C	I
	Kinder-garten	**Life Science**			
	K.4 LS	**Molecules to Organisms: Structures and Processes (NGSS K-ESS2)**			
	K.4a	**Use observations to describe patterns of what plants and animals (including humans) need to survive. (NGSS K-LS1-1)** ● Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.	Q	C	I
	Kinder-garten	**Earth Science**			
	K.5 ES	**Earth's Systems (NGSS K-ESS2)**			
	K.5a	**Use information to share observations of local weather conditions to describe patterns over time. (NGSS K-ESS2-1)** ● Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months. ● *Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*	Q	C	

	K.5b	**Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. (NGSS K-ESS2-2)** ● Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.	Q	C	I
	K.6 ES	**Earth and Human Activity (NGSS K-ESS3)**			
	K.6a	**Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. (NGSS K-ESS3-1)** ● Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.	Q	C	I
	K.6b	**Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. (NGSS K-ESS3-2)** ● Clarification Statement: Emphasis is on local forms of severe weather.	Q	C	I
	K.6c	**Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (NGSS K-ESS3-3)** ● Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.	Q	C	I
	Kinder-garten	**Science in Personal and Social Perspectives**			
	K.7a	**Demonstrate knowledge of personal hygiene/good and bad choices: cleanliness; nutrition; exercise/rest** ● Clarification Statement: Examples of washing hands, brushing teeth, healthy eating, and healthy physical activities	Q	C	I
	K.7b	**Identify safety rules for home and school** ● Clarification Statement: Examples of street safety, fire safety, intruder safety, and playground safety.	Q	C	I

Program Standards
"**Q**" stands for **Inquiry**; "**C**" stands for **Connections (**NGSS Cross-cutting concepts); "**I**" stands for **Influence**

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Assessment boundary statements *specify the limits to large scale assessment.*

Abilities to do Scientific Inquiry (NDE SC2 1.1a-g)
Science Process Skills for Integrating Inquiry into the Content Areas
*The following scientific process skills will be **integrated throughout the content areas** for grades K-2. These skills should be mastered at the appropriate level by the end of second grade.*

	Inquiry 1.1a	**Observe investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Conduct Simple Investigations ○ Select and use simple tools appropriately ○ Describe objects, organisms, or events using pictures, words, and numbers ○ Collect and record observations ○ Use drawings and words to describe and share observations with others ○ Use appropriate mathematics in all aspects of science inquiry			
✓	**Grade Level**	Content Standard Strand	**Program Standards**		
	Grade 1	**Physical Science**	**Q**	**C**	**I**
	1.2 PS	**Waves and their Applications in Technologies for Information Transfer (NGSS 1-PS4)**			
	1.2a	**Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (NGSS 1-PS4-1)** ● Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.	Q	C	

	1.2b	**Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. (NGSS 1-PS4-2)** ● Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.	Q	C	
	1.2c	**Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. (NGSS 1-PS4-3)** ● Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror). ● *Assessment Boundary: Assessment does not include the speed of light.*	Q	C	
	Grade 1	**Life Science**			
	1.3 LS	**From Molecules to Organisms: Structures and Processes (NGSS 1-LS1)**			
	1.3a	**Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. (NGSS 1-LS1-1)** ● Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.	Q	C	I
	1.3b	**Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. (NGSS 1-LS1-2)** ● Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).	Q	C	I

	1.4 LS	**Heredity: Inheritance and Variation of Traits (NGSS 1-LS3)**			
	1.4a	**Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. (NGSS 1-LS3-1)** ● Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same. ● *Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.*	Q	C	
	1.4a	**Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. (NGSS 1-LS3-1)** ● Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same. ● *Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.*	Q	C	
	Grade 1	**Earth Science**			
	1.5 ES	**Earth's Place in the Universe (NGSS K-ESS1)**			
	1.5a	**Use observations of the sun, moon, and stars to describe patterns that can be predicted. (NGSS K-ESS1-1)** ● Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day. ● *Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*	Q	C	
	1.5b	**Make observations at different times of year to relate the amount of daylight to the time of year. (NGSS K-ESS1-2)** ● Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall. ● *Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*	Q	C	

	Grade 1	Science in Personal and Social Perspectives			
	1.6a	**Recognize the importance of personal choices and how they affect the body.** • Clarification Statement: Examples of cleanliness, nutrition, and exercise/rest.	Q	C	I

Program Standards
"**Q**" stands for **Inquiry**; "**C**" stands for **Connections (**NGSS Cross-cutting concepts);
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Abilities to do Scientific Inquiry (NDE SC2 1.1a-g)
Science Process Skills for Integrating Inquiry into the Content Areas
*The following scientific process skills will be **integrated throughout the content areas** for grades K-2. These skills should be mastered at the appropriate level by the end of second grade.*

	Inquiry 2.1a	**Observe investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Conduct Simple Investigations ○ Select and use simple tools appropriately ○ Describe objects, organisms, or events using pictures, words, and numbers ○ Collect and record observations ○ Use drawings and words to describe and share observations with others ○ Use appropriate mathematics in all aspects of science inquiry			
✓	**Grade Level**	Content Standard Strand	**Program Standard**		
	Grade 2	**Physical Science**	**Q**	**C**	**I**
	2.2 PS	**Matter and Its Interactions (NGSS 2-PS1)**			
	2.2a	**Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. (NGSS 2-PS1-1)** ● Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.	Q	C	

	2.2b	**Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (NGSS 2-PS1-2)** ● Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency. ● *Assessment Boundary: Assessment of quantitative measurements is limited to length.*	Q	C	
	2.2c	**Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. (NGSS 2-PS1-3)** ● Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.	Q	C	
	2.2d	**Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. (NGSS 2-PS1-4)** ● Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.	Q	C	
	Grade 2	**Life Science**			
	2.3 LS	**Ecosystems: Interactions, Energy, and Dynamics (NGSS 2-LS2)**			
	2.3a	**Plan and conduct an investigation to determine if plants need sunlight and water to grow. (NGSS 2-LS2-1)** ● *Assessment Boundary: Assessment is limited to testing one variable at a time.*	Q	C	I
	2.3b	**Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. (NGSS 2-LS2-2)**	Q	C	I
	2.4 LS	**Biological Evolution: Unity and Diversity (NGSS 2-LS4)**			
	2.4a	**Make observations of plants and animals to compare the diversity of life in different habitats. (NGSS 2-LS4-1)** ● Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats. ● *Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.*	Q	C	I

	Grade 2	**Earth Science**			
	2.5 ES	**Earth's Place in the Universe (NGSS 2-ESS1)**			
	2.5a	**Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (NGSS 2-ESS1-1)** ● Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly. ● *Assessment Boundary: Assessment does not include quantitative measurements of timescales.*	Q	C	I
	2.6 ES	**Earth's Systems (NGSS 2-ESS2)**			
	2.6a	**Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. (NGSS 2-ESS2-1)** ● Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.	Q	C	I
	2.6b	**Develop a model to represent the shapes and kinds of land and bodies of water in an area. (NGSS 2-ESS2-2)** ● *Assessment Boundary: Assessment does not include quantitative scaling in models.*	Q	C	
	2.6c	**Obtain information to identify where water is found on Earth and that it can be solid or liquid. (NGSS 2-ESS-3)**	Q	C	
	Grade 2	**Science in Personal and Social Perspectives**			
	2.7a	**Construct a model to show the importance of personal choices and how they affect the body through nutrition and exercise/rest.** ● Clarification Statement: Examples of an exercise plan or a healthy meal plan	Q	C	I
	2.7b	**Describe how different substances can damage the body and alter how the body functions.** ● Clarification Statement: Discussion of the effects of drugs/alcohol/tobacco	Q	C	I

Intermediate Grades 3-5

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24-39 CONTENT STANDARDS CHECKLIST

Intermediate Grades 3-5
Science Essential Standards

Standard #1: INQUIRY

Plan and conduct simple investigations and discuss results

Standard #2: CONNECTIONS

Connect interdisciplinary concepts through the use of critical thinking skills

Standard #3: INFLUENCE

Research the impact of science on self, surrounding community and environment

Directions for Use of Content Standards

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Abilities to do Scientific Inquiry (NDE SC5.1.1.a-i) **Science Process Skills for Integrating Inquiry into the Content Areas** *The following scientific process skills will be* ***integrated throughout the content areas*** *for Grades 3-5. These skills should be mastered at the appropriate level by the end of fifth grade.*	
Grade 3 **Inquiry** 3.1	**Plan and conduct investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Plan and conduct investigations and identify factors that have the potential to impact an investigation ○ Select and use equipment correctly and accurately ○ Make relevant observations and measurements ○ Collect and organize data ○ Develop a reasonable explanation based on collected data ○ Share information, procedures, and results with peers and/or adults ○ Provide feedback on scientific investigations ○ Use appropriate mathematics in all aspects of scientific inquiry
Inquiry 3.2	**Nature of Science (NDE SC5.1.2.a-c)**
3.2.a	**Describe how scientists go about their work.** ● Clarification Statement: Students should be able to do the following: ○ Recognize that scientific explanations are based on evidence and scientific knowledge ○ Recognize that new discoveries are always being made which impact scientific knowledge ○ Recognize many different people study science

Inquiry 3.3	Technology (NDE SC 5.1.3.a-e)
3.3.a	**Solve a simple design problem.** ● Clarification Statement: Students should be able to do the following: ○ Identify a simple problem ○ Propose a solution to a simple problem ○ Implement the proposed solution ○ Evaluate the implementation ○ Communicate the problem, design, and solution
Inquiry 3.4	**Engineering and Design**
3.4.a	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (NGSS 3-5-ETS1-1)**
3.4.b	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (NGSS 3-5-ETS1-2)**
3.4.c	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (NGSS 3-5-ETS1-3)**

✓	Grade Level	Content Standard Strand				Program Standard
	Grade 3	**Physical Science**	Q	C	I	
3.5 PS		**Motion and Stability: Forces and Interactions (NGSS 3-PS2)**				
	3.5.a	**Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (NGSS 3-PS2-1)** ● Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all. ● *Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*	Q	C		
	3.5.b	**Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (NGSS 3-PS2-2)** ● Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, pendulum, a ball rolling back and forth in a bowl, and two children on a see-saw. ● *Assessment Boundary: Assessment does not include technical terms such as*	Q	C		

		period and frequency.			
	3.5.c	**Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (NGSS 3-PS2-3)** ● Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force. ● *Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.*	Q	C	
	3.5.d	**Define a simple design problem that can be solved by applying scientific ideas about magnets. (NGSS 3-PS2-4)** ● Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.	Q	C	I

Grade 3	**Life Science**				
3.6 LS	**From Molecules to Organisms: Structures and Processes (NGSS 3-LS1)**				
	3.6.a	**Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. (NGSS 3-LS1-1)** ● Clarification Statement: Changes organisms go through during their life form a pattern. ● *Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.*	Q	C	I
3.7 LS	**Ecosystems: Interactions, Energy, and Dynamics (NGSS 3-LS2)**				
	3.7.a	**Construct an argument that some animals form groups that help members survive. (NGSS 3-LS2-1)** Clarification Statement: Being a part of a big group helps animals obtain food, defend themselves and cope with changes. Groups may serve different functions and vary dramatically in size.	Q	C	I
3.8 LS	**Heredity: Inheritance and Variation of Traits (NGSS 3-LS3)**				
	3.8.a	**Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. (NGSS 3-LS3-1)** ● Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans. ● *Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.*	Q	C	
	3.8.b	**Use evidence to support the explanation that traits can be influenced by the environment. (NGSS 3-LS3-2)** ● Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.	Q	C	
3.10 ES	**Earth's systems (NGSS 3-ESS2)**				
	3.10.a	**Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (NGSS 3-ESS2-1)** ● Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. ● *Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*	Q	C	

3.9 LS	**Biological Evolution: Unity and Diversity (NGSS 3-LS4)**				
	3.9.a	**Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (NGSS 3-LS4-1)** ● Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms. ● *Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.*	Q	C	
	3.9.b	**Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (NGSS 3-LS4-2)** ● Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.	Q	C	
	3.9.c	**Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (NGSS 3-LS403)** ● Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.	Q	C	
	3.9.d	**Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. (NGSS 3-LS4-4)** ● Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms. ● *Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.*	Q	C	I
Grade 3	**Earth Science**				
	3.10.b	**Analyze and interpret data from maps to describe patterns of Earth's features. (NGSS 3-ESS2-2)** ● Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.	Q	C	

3.11 ES	**Earth and Human Activity (NGSS 3-ESS3)**				
	3.11.a	**Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. (NSGG 3-ESS3-1)** • Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.	Q	C	I
Grade 3	**Science in Personal and Social Perspectives**				
	3.12.a	**Develop an understanding and appreciation of our God-given resources.**	Q	C	I

Program Standards
"**Q**" stands for **Inquiry**; "**C**" stands for **Connections (**NGSS Cross-cutting concepts**)**;
"**I**" stands for **Influence**

Within each content standard strand, NGSS standards equivalence
is given in parentheses (e.g.NGSS-3-LS1)
Visit www.nextgenscience.org for more information about these standards.

Clarification statements supply examples or additional clarification to the performance expectations.
Assessment boundary statements *specify the limits to large scale assessment.*

Abilities to do Scientific Inquiry (NDE SC5.1.1.a-i) **Science Process Skills for Integrating Inquiry into the Content Areas** *The following scientific process skills will be* ***integrated throughout the content areas*** *for Grades 3-5. These skills should be mastered at the appropriate level by the end of fifth grade.*	
Grade 4 Inquiry 4.1	**Plan and conduct investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Plan and conduct investigations and identify factors that have the potential to impact an investigation ○ Select and use equipment correctly and accurately ○ Make relevant observations and measurements ○ Collect and organize data ○ Develop a reasonable explanation based on collected data ○ Share information, procedures, and results with peers and/or adults ○ Provide feedback on scientific investigations ○ Use appropriate mathematics in all aspects of scientific inquiry
Inquiry 4.2	**Nature of Science (NDE SC5.1.2a-c)**
4.2.a	**Describe how scientists go about their work.** ● Clarification Statement: Recognize that scientific explanations are based on evidence and scientific knowledge ○ Recognize that new discoveries are always being made which impact scientific knowledge ○ Recognize many different people study science

Inquiry 4.3	**Technology (NDE SC5.1.3a-e)**
4.3.a	**Solve a simple design problem.** ● Clarification Statement: Students should be able to do the following: ○ Identify a simple problem ○ Propose a solution to a simple problem ○ Implement the proposed solution ○ Evaluate the implementation ○ Communicate the problem, design, and solution
Inquiry 4.4	**Engineering and Design**
4.4.a	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
4.4.b	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
4.4.c	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

✓	**Grade Level**	**Content Standard Strand**	**Program Standard**		
	Grade 4	**Physical Science**	**Q**	**C**	**I**
4.5 PS		**Energy (NGSS 4-PS3)**			
	4.5.a	**Use evidence to construct an explanation relating the speed of an object to the energy of that object. (NGSS 4-PS3-1)** ● *Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*	Q	C	
	4.5.b	**Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. (NGSS 4-PS3-2)** ● *Assessment Boundary: Assessment does not include quantitative measurements of energy.*	Q		
	4.5.c	**Ask questions and predict outcomes about the changes in energy that occur when objects collide. (NGSS 4-PS3-3)** ● Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. ● *Assessment Boundary: Assessment does not include quantitative measurements of energy.*	Q	C	

	4.5.d	**Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (NGSS 4-PS3-4)** ● Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. ● *Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*	Q		I
4.6 PS		**Waves and Their Applications in Technologies for Information Transfer (NGSS 4-PS4)**			
	4.6.a	**Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (NGSS 4-PS4-1)** ● Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. ● *Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*	Q		
	4.6.b	**Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (NGSS 4-PS4-2)** ● *Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*	Q		
	4.6.c	**Generate and compare multiple solutions that use patterns to transfer information. (NGSS 4-PS4-3)** ● Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.	Q	C	
Grade 4		**Life Science**			
4.7 LS		**From Molecules to Organisms: Structures and Processes (NGSS 4-LS1)**			
	4.7.a	**Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (NGSS 4-LS1-1)** ● Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, exoskeleton, vertebrae, heart, stomach, lung, brain, and skin. ● *Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.*	Q		

	4.7.b	**Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (NGSS 4-LS1-2)** ● Clarification Statement: Emphasis is on systems of information transfer. ● *Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*	Q		

Grade 4	**Earth Science**				
4.8 ES	**Earth's Place in the Universe (NGSS 4-ESS1)**				
	4.8.a	**Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (NGSS 4-ESS1-1)** ● Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. ● *Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*	Q	C	
	4.8.b	**Identify characteristics of the following types of rocks: sedimentary, igneous, and metamorphic.**	Q		
4.9 ES	**Earth's Systems (NGSS 4-ESS2)**				
	4.9.a	**Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (NGSS 4-ESS2-1)** ● Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. ● *Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*	Q	C	
	4.9.b	**Analyze and interpret data from maps to describe patterns of Earth's features. (NGSS 4-ESS2-2)** ● Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.	Q	C	

4.10 ES	**Earth and Human Activity (NGSS 4-ESS3)**				
	4.10.a	**Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (NGSS 4-ESS3-1)** ● Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; nonrenewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.	Q	C	I
	4.10.b	**Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. (NGSS 4-ESS3-2)** ● Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. ● *Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*	Q	C	I
Grade 4	**Science in Personal and Social Perspectives**				
	4.11.a	**Develop an understanding of personal health.** ● Demonstrate knowledge of cleanliness; nutrition; exercise; rest; safety rules at home and school; how our choices affect our choices affect our bodies	Q	C	
	4.11.b	**Describe how different substances can damage the body and alter how the body functions: drugs, alcohol, tobacco**	Q	C	

Program Standards
"**Q**" stands for **Inquiry**; "**C**" stands for **Connections (**NGSS Cross-cutting concepts**);**
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Assessment boundary statements *specify the limits to large scale assessment.*

Abilities to do Scientific Inquiry (NDE SC5.1.1.a-i) **Science Process Skills for Integrating Inquiry into the Content Areas** *The following scientific process skills will be* ***integrated throughout the content areas*** *for Grades 3-5. These skills should be mastered at the appropriate level by the end of fifth grade.*	
Grade 5 Inquiry 5.1	**Plan and conduct investigations that lead to the development of explanations.** ● Clarification Statement: Students should be able to do the following: ○ Ask a testable scientific question ○ Plan and conduct investigations and identify factors that have the potential to impact an investigation ○ Select and use equipment correctly and accurately ○ Make relevant observations and measurements ○ Collect and organize data ○ Develop a reasonable explanation based on collected data ○ Share information, procedures, and results with peers and/or adults ○ Provide feedback on scientific investigations ○ Use appropriate mathematics in all aspects of scientific inquiry
Inquiry 5.2	**Nature of Science**
5.2.a	**Describe how scientist go about their work.** ● Clarification Statement: Students should be able to do the following: ○ Recognize that scientific explanations are based on evidence and scientific knowledge ○ Recognize that new discoveries are always being made which impact scientific knowledge ○ Recognize many different people study science
Inquiry 5.3	**Technology (NDE SC 5.1.3)**
5.3.a	**Solve a simple design problem,** ● Clarification Statement: Students should be able to do the following: ○ Identify a simple problem ○ Propose a solution to a simple problem ○ Implement the proposed solution ○ Evaluate the implementation ○ Communicate the problem, design, and solution

Inquiry 5.4	Engineering and Design
5.4.a	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (NGSS 3-5-ETS1-1)**
5.4.b	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (NGSS 3-5-ETS1-2)**
5.4.c	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (NGSS 3-5-ETS1-3)**

✓	Grade Level	Content Standard Strand	Program Standard		
	Grade 5	**Physical Science**	**Q**	**C**	**I**
5.5 PS		**Matter and Its Interactions (NGSS 5-PS1)**			
	5.5.a	**Develop a model to describe that matter is made of particles too small to be seen. (NGSS 5-PS1-1)** ● Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. ● *Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*	Q	C	I
	5.5.b	**Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (NGSS 5-PS1-2)** ● Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances. ● *Assessment Boundary: Assessment does not include distinguishing mass and weight.*	Q	C	I

	5.5.c	**Make observations and measurements to identify materials based on their properties. (NGSS 5-PS1-3)** ● Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property. ● *Assessment Boundary: Assessment does not include density or distinguishing mass and weight.*	Q	C	I
	5.5.d	**Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (NGSS-5-PS1-4)**	Q	C	I
5.6 PS		**Motion and Stability: Forces and Interactions (NGSS 5-PS2)**			
	5.6.a	**Support an argument that the gravitational force exerted by Earth on objects is directed down. (NGSS 5-PS2-1)** ● Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth. ● *Assessment Boundary: Assessment does not include mathematical representation of gravitational force.*	Q	C	I
5.7 PS		**Energy (NGSS 5-PS3)**			
	5.7.a	**Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (NGSS 5-PS3-1)** ● Clarification Statement: Examples of models could include diagrams and flowcharts.	Q	C	I
Grade 5		**Life Science**			
5.8 LS		**From Molecules to Organisms: Structures and Processes (NGSS 5-LS1)**			
	5.8a	**Support an argument that plants get the materials they need for growth chiefly from air and water. (NGSS 5-LS1-1)** ● Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.	Q		
5.9 LS		**Ecosystems: Interactions, Energy, and Dynamics (NGSS 5-LS2)**			
	5.9.a	**Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (NGSS 5-LS2-1)** ● Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth. ● *Assessment Boundary: Assessment does not include molecular explanations.*	Q	C	I

Grade 5		Earth Science			
5.10 ES		**Earth's Place in the Universe (NGSS 5-ESS1)**			
	5.10.a	**Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth. (NGSS 5-ESS1-1)** ● *Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*	Q	C	I
	5.10.b	**Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (NGSS 5-ESS1-2)** ● Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months. ● *Assessment Boundary: Assessment does not include causes of seasons.*	Q	C	I
5.11 ES		**Earth's Systems (NGSS 5-ESS2)**			
	5.11.a	**Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (NGSS 5-ESS2-1)** ● Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system. ● *Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*	Q	C	I
	5.11.b	**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. (NGSS 5-ESS2-2)** ● *Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*	Q	C	I
5.12 ES		**Earth and Human Activity (NGSS 5-ESS3)**			
	5.12.a	**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. (NGSS 5-ESS3-1)**	Q	C	I

Grade 5		Science in Personal and Social Perspectives			
	5.13.a	**Describe how recycling and pollution affects the environment.**	Q	C	I
	5.13.b	**Describe human activities (e.g., urban growth, land use, and waste disposal) which can accelerate many natural changes.**	Q	C	I
	5.13.c	**Distinguish between natural environmental changes and human influenced changes/good and bad choices.**	Q	C	I

Middle School Grades 6-8

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Middle School Grades 6-8
Science Essential Standards

Standard #1: INQUIRY

Design and conduct appropriate investigations in order to find valid solutions

Standard #2: CONNECTIONS

Analyze relationships within and between systems and disciplines using critical thinking skills

Standard #3: INFLUENCE

Investigate and evaluate the impact of science on personal and social decisions

Directions for Use of Content Standards

The grade level Content Standards are designed to accompany the Essential Standards. Faculty discussion will need to take place to ensure consistency in teaching. The administrator should reproduce the Content Standards and distribute them to all the teachers.

The format for the Content Standards is as follows:

1. Blank box to record date of instruction of content standards or to use as a check-off to indicate that instruction of standards occurred
2. Numeric system that identifies the specific standard statement
3. Standard Strand
4. Next Generation Science Standard Reference Number **(NGSS)**
5. Program Standard Reference: Inquiry (Q), Connection (C), Influence (I)

Teachers will use this guide as the basis for planning their lessons for the year. Use of the guide will assist students in attaining the Standards for which all are accountable. Teachers are required to spend 80% of their time teaching strictly from the curriculum guide with the remaining 20% of their time teaching concepts that enhance the curriculum.

Program Standards

"**Q**" stands for **Inquiry**; "**C**" stands for **Connections** (NGSS Cross-cutting concepts); "**I**" stands for **Influence**

Within each content standard strand, the Next Generation Science Standards (NGSS) equivalence is given in parentheses (e.g., NGSS MS-PS1-1)
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Science Process Skills for Integrating Inquiry into the Content Areas

*The following Middle School (MS) scientific process skills will be **integrated throughout the content** areas for grades 6-8. These skills should be mastered at the appropriate level by the end of 8th grade.*

Inquiry MS.a	**Abilities to do Scientific Inquiry**
	Design and conduct investigations that will lead to descriptions of relationships between evidence and explanations. ● Clarification Statement: Students should be able to do the following: ○ Formulate testable questions that lead to predictions and scientific investigations ○ Design and conduct logical and sequential investigations including repeated trials ○ Determine controls and use dependent (responding) and independent (manipulated) variables ○ Select and use equipment appropriate to the investigation; demonstrate correct techniques ○ Make qualitative and quantitative observations ○ Record and represent data appropriately and review for quality, accuracy, and relevancy ○ Evaluate predictions, draw logical inferences based on observed patterns/relationships, and account for non-relevant information ○ Share information, procedures, results, and conclusions with appropriate audiences ○ Analyze and provide appropriate critique of scientific investigations ○ Use appropriate mathematics in all aspects of scientific inquiry

Inquiry MS.b	Abilities to do Engineering Design
	Use the following steps to come up with a solution to a problem or solve a certain task. ● Clarification Statement: Students should be able to do the following: ○ Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **(NGSS MS-ETS1-1)** ○ Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **(NGSS MS-ETS1-2)** ○ Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **(NGSS MS-ETS1-3)** ○ Develop a model to generate data for repeated testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **(NGSS MS-ETS1-4)**

✓	Grade Level	Content Standard Strand	Progam Standard		
	MS.PS	**Physical Science**	**Q**	**C**	**I**
	MS.PS.1	**Structure and Properties of Matter**			
	PS.1.a	**Develop models to describe the subatomic structure and atomic composition of simple molecules. (NGSS MS-PS1-1)** ● Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of molecular-level models could include drawings, 3D ball and stick structures or computer representations showing different molecules with different types of atoms. ● *Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.*		C	
	PS.1.b	**Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. (NGSS MS-PS1-3)** ● Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] ● *Assessment Boundary: Assessment is limited to qualitative information.*	Q	C	I
	PS.1.c	**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. (NGSS MS-PS1-4)** ● 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 include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.	Q	C	

	MS.PS 2	**Chemical Reactions**			
	PS.2.a	**Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (NGSS MS-PS1-2)** ● Clarification Statement: Includes discrimination between physical and chemical changes. Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl. ● *Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.*	Q	C	
	PS.2.b	**Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. (NGSS MS-PS1-5)** ● Clarification Statement: Emphasis is on law of conservation of matter, and on physical models or drawings, including digital forms that represent atoms. ● *Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.*	Q	C	
	MS.PS.3	**Forces and Interactions**			
	PS.3.a	**Apply Newton's Laws to design a solution to a problem involving motion. (NGSS MS-PS2-1 and MS-PS2-2)** ● Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.	Q	C	
	PS.3.b	**Use evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (NGSS MS-PS2-4)** ● Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system. ● *Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.*	Q	C	
	PS.3.c	**Demonstrate how simple machines make work easier.** ● Clarification Statement: Emphasis is on how simple machines transfer energy. Examples include experiments demonstrating mechanical advantage using levers, pulleys, or other simple machines.	Q	C	I

	MS.PS.4	Energy			
	PS.4.a	**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. (NGSS MS-PS3-1)** ● Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.	Q	C	
	PS.4.b	**Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. (NGSS MS-PS3-2)** ● Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.	Q	C	
	PS.4.c	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (NGSS MS-PS3-3)** ● 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.*	Q	C	I
	PS.4.d	**Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (NGSS MS-PS3-4)** ● Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. ● *Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.*	Q	C	

	PS.4.e	**Construct, use, and present evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (NGSS MS-PS3-5)** ● Clarification Statement: Examples of empirical evidence could include a representation of the energy before and after the transfer in the form of temperature changes or motion of object. ● *Assessment Boundary: Assessment does not include calculations of energy.*	Q	C	
	MS.PS.5	**Waves and Electromagnetic Spectrum**			
	PS.5.a	**Use mathematical representations to describe a simple model for waves that includes how the amplitude and frequency of a wave is related to the energy in a wave. (NGSS MS-PS4-1)** ● Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking. ● *Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.*	Q	C	
	PS.5.b	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** **(NGSS MS-PS4-2)** ● 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.*	Q	C	
	PS.5.c	**Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (NGSS MS-PS4-3)** ● 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. ● *Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.*	Q	C	I

✓	MS.LS	Life Science	Q	C	I
	MS.LS.1	**Structure, Function and Information Processing**			
	LS.1.a	**Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. (NGSS MS-LS1-1)** ● Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one cell or many and varied cells.	Q	C	
	LS.1.b	**Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (NGSS MS-LS1-2)** ● Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. ● *Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.*	Q	C	
	LS.1.c	**Use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (NGSS MS-LS1-3)** ● Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. ● *Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the skeletal, circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*		C	I
	LS.1.d	**Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (NGSS MS-LS1-8)** ● *Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.*	Q	C	

	MS.LS.2	Matter, Energy and Relationships within Organisms and Ecosystems			
	LS.2.a	**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. (NGSS MS-LS1-6)** ● Clarification Statement: Emphasis is on tracing movement of matter and flow of energy. ● *Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.*		C	I
	LS.2.b	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (NGSS MS-LS1-7)** ● Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released. ● *Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.*	Q	C	I
	LS.2.c	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (NGSS MS-LS2-1)** ● Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.		C	I
	LS.2.d	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (NGSS MS-LS2-3)** ● Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. ● *Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.*	Q	C	
	LS.2.e	**Construct an argument supported by empirical evidence that when physical or biological components of an ecosystem are changed, populations are affected. (NGSS MS-LS2-4)** ● Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.		C	I

	LS.2.f	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (NGSS MS-LS2-2)** ● Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.		C	I
	LS.2.g	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* (NGSS MS-LS2-5)** ● Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.	Q	C	I
	MS.LS.3	**Study of Genes, Genetic Variation, and Heredity**			
	LS.3.a	**Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. (NGSS MS-LS1-4)** ● Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.		C	I
	LS.3.b	**Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (NGSS MS-LS1-5)** ● 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.*	Q	C	

	LS.3.c	**Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. (NGSS MS-LS3-1)** ● Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins. ● *Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*	Q	C	I
	LS.3.d	**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. (NGSS MS-LS3-2)** ● Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.	Q	C	
	LS.3.e	**Gather, synthesize, and discuss the ethics of the technologies that have changed the way humans influence the inheritance of desired traits in organisms. (NGSS MS-LS4-5)** ● Clarification Statement: Emphasis is on synthesizing information from reliable sources, including Catholic Church teachings (Example: CCC# 2275), about the influence of humans on genetic outcomes in artificial selection (such as genetically modified organisms (GMOs), animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.		C	I
	MS.LS.4	**Natural Selection and Adaptations**			
	LS.4.a	**Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. (NGSS MS-LS4-1)** ● Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers. ● *Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.*	Q	C	

	LS.4.b	**Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (NGSS MS-LS4-2)** ● Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.	Q	C	
	LS.4.c	**Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.** **(NGSS MS-LS4-3)** ● Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. ● *Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.*	Q	C	
	LS.4.d	**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. (NGSS MS-LS4-4)** ● Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.	Q	C	I
	LS.4.e	**Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. (NGSS MS-LS4-6)** ● Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time. ● *Assessment Boundary: Assessment does not include Hardy Weinberg calculations.*	Q	C	
✓	**MS.ESS**	**Earth and Space Science**	**Q**	**C**	**I**
	MS.ESS.1	**Space Systems**			
	ESS.1.a	**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, day, year, and seasons. (MS-ESS1-1)** ● Clarification Statement: Examples of models can be physical, graphical, or conceptual.	Q	C	

	ESS.1.b	**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. (MS-ESS1-2)** ● Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state). ● *Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.*	Q	C	
	ESS.1.c	**Analyze and interpret data to determine scale properties of objects in the solar system. (NGSS MS-ESS1-3)** ● 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 (includes knowledge of the planets, meteors, comets, and asteroids). Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), composition, 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.*		C	
	MS.ESS.2	**History of Earth**			
	ESS.2.a	**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. (NGSS MS-ESS1-4)** ● 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.*	Q	C	

	ESS.2.b	**Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (NGSS MS-ESS2-2)** ● Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.		C	I
	ESS.2.c	**Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. (NGSS MS-ESS2-3)** ● Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches). ● *Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.*	Q	C	
	MS.ESS.3	**Earth's Systems**			
	ESS.3.a	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. (NGSS MS-ESS2-1)** ● Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.	Q	C	
	ESS.3.b	**Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. (NGSS MS-ESS2-4)** ● Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical. ● *Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.*	Q	C	

	ESS.3.c	**Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (NGSS MS-ESS3-1)** ● 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).		C	I
	MS.ESS.4	**Weather and Climate**			
	ESS.4.a	**Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. (NGSS MS-ESS2-5)** ● Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation). ● *Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.*	Q	C	I
	ESS.4.b	**Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (NGSS MS-ESS2-6)** ● Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations. ● *Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.*	Q	C	

	ESS.4.c	**Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. (NGSS MS-ESS3-5)** ● 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.	Q	C	I
	MS.ESS.5	**Human Impact (Science in Personal and Social Perspective)**			
	ESS.5.a	**Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (NGSS MS-ESS3-2)** ● Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and without notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).	Q	C	I

	ESS.5.b	**Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (NGSS MS-ESS3-3)** ● Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).	Q	C	I
	ESS.5.c	**Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (NGSS MS-ESS3-4)** ● Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.		C	I

High School Grades 9-12

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High School Grades 9-12
Science Essential Standards

Standard #1: INQUIRY

Design and conduct complex investigations using multiple variables utilizing technology to evaluate and communicate results

Standard #2: CONNECTIONS

Evaluate relationships within and between systems and disciplines using critical thinking skills

Standard #3: INFLUENCE

Evaluate and predict long-term effects of science, technology, and engineering on humanity and our environment

Directions for Use of Content Standards

The grade level Content Standards are designed to accompany the Essential Standards. Faculty discussion will need to take place to ensure consistency in teaching. The administrator should reproduce the Content Standards and distribute them to all the teachers.

The format for the Content Standards is as follows:

1. Blank box to record date of instruction of content standards or to use as a check-off to indicate that instruction of standards occurred
2. Numeric system that identifies the specific standard statement
3. Standard Strand
4. Next Generation Science Standard Reference Number **(NGSS)**
5. Program Standard Reference: Inquiry (Q), Connection (C), Influence (I)

Teachers will use this guide as the basis for planning their lessons for the year. Use of the guide will assist students in attaining the Standards for which all are accountable. Teachers are required to spend 80% of their time teaching strictly from the curriculum guide with the remaining 20% of their time teaching concepts that enhance the curriculum.

Archdiocese of Omaha Grades 9-12 Science Standards
Physical Science and Life Science Standards
Adapted from Next Generation Science Standards (NGSS)
For more information and resources:
www.nextgenscience.org
www.concord.org

Program Standards: Q – Inquiry; C – Connections; I- Influence

Check-off		Content Standard Strand	Program Standards		
	HS	**High School – Physical Science**	**Q**	**C**	**I**
	HS-PS1	**HS-PS1 Matter and Its Interactions**			
	HS PS1-1	**Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.** [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [*Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*]	Q	C	
	HS PS1-2	**Construct an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.** [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [*Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.*]	Q	C	
	HS PS1-3	**Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of forces between particles.** [Clarification Statement: Emphasis is on understanding the strength between particles of solids, liquids, and gases, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite, diamond, Buckyballs). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [*Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.*]	Q	C	

	HS PS1-4	**Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.** [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [*Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.*]	Q	C	
	HS PS1-5	**Apply scientific principles and evidence to provide an explanation about the effects of variables which change the rate at which a chemical reaction occurs.** [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules based on changes in temperature, concentration, or surface area.] [*Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.*]	Q	C	
	HS PS1-6	**Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.** [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [*Assessment Boundary: Assessment does not include complex chemical reactions.*]	Q	C	

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3)
- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.B: Chemical Reactions

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)
- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-5)
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2)

PS1.C: Types of Interactions

- **Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.** ***(secondary to HS-PS1-1),(secondary to HS-PS1-3)***

	HSPS2	**Motion and Stability: Forces and Interactions**			
	HS PS2-1	**Analyze data to support the claim that Newton's first law of motion describes the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion, frame of reference, and specification of units.] [*Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time.*]	Q	C	
	HS PS2-2	**Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.** [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [*Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.*]	Q	C	
	HS PS2-3	**Recognize and describe examples of Newton's third law of motion which demonstrates forces occur in equal and opposite pairs.** [Clarification Statement: Emphasis is on forces acting on different objects, not necessarily resulting in equal movement.]		C	

	HS PS2-4	**Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.** [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [*Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.*]	Q	C	
	HS PS2-5	**Use representations of Newton's Law of Gravity to describe and predict the gravitational forces between objects.** [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational. [*Assessment Boundary: Assessment is limited to systems with two objects.*]	Q	C	

Disciplinary Core Ideas

PS2.A: Forces and Motion

- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-2)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-4)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-4)

PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-5)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-5)
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. *(secondary to HS-PS1-1),(secondary to HS-PS1-3)*

	HS-PS3	**Energy**			
	HS PS3-1	**Create and use a model to calculate a change in energy when energy flows within, or in and out of a system.** [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, or the conversion of potential energy to kinetic energy. Examples of models could include diagrams, drawings, descriptions, and computer simulations.] [*Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.*]	Q	C	
	HS PS3-2	**Design and build a device that works within given constraints to convert one form of energy into another form of energy.** [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [*Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.*]	Q	C	
	HS PS3-3	**Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).** [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [*Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.*]	Q	C	

	HS PS3-4	**Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.** [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [*Assessment Boundary: Assessment is limited to systems containing two objects.*]	Q	C	

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-1) (HS-PS3-2)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-1)

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-3)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-3)

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-4)

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-2),(HS-PS3-3)

	HS-PS4	**Waves and Electromagnetic Radiation**			
	HS PS4-1	**Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [*Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.*]	Q	C	
	HS PS4-2	**Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model.** [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [*Assessment Boundary: Assessment does not include using quantum theory.*]	Q	C	
	HS PS4-3	**Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.** [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [*Assessment Boundary: Assessment is limited to qualitative descriptions.*]	Q	C	I

Disciplinary Core Ideas

PS4.A: Wave Properties

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
- Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-2)

PS4.B: Electromagnetic Radiation

- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-2)
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-3)

	HS-PS5	**Human Influence on Physical Science**			
	HS PS5-1	**Explain and evaluate an ethical solution addressing the use of advanced technology.** [Clarification Statement: Examples could include alternative energy sources, nuclear processes (fission and fusion), global climate change, chemical warfare, robotics, pharmaceuticals, and chemical engineering. **Note: Solutions should not conflict with Catholic Church teachings.**		C	I

Archdiocese of Omaha Grades 9-12 Science Standards
Physical Science and Life Science Standards
Adapted from Next Generation Science Standards (NGSS)
For more information and resources:
www.nextgenscience.org
www.concord.org

Program Standards: Q – Inquiry; C – Connections; I- Influence

Check-off		Content Standard Strand	Program Standards		
	HS-LS	**High School – Life Science**	**Q**	**C**	**I**
	HS-LS1	**From Molecules to Organisms: Structures and Processes**			
	HS LS1-1	**Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.** [*Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.*]	Q	C	
	HS LS1-2	**Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]	Q	C	
	HS LS1-3	**Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]	Q	C	
	HS LS1-4	**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** [Clarification Statement: Emphasis on how mitosis creates growth, but when uncontrolled can lead to cancer.] [*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*]	Q	C	I

	HS LS1-5	**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [*Assessment Boundary: Assessment does not include specific biochemical steps.*]	Q	C	
	HS LS1-6	**Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] *[Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*]	Q	C	

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
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LS1.B: Growth and Development of Organisms

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

LS1.C: Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-6)

	HS-LS2	**Ecosystems: Interactions, Energy, and Dynamics**			
	HS LS2-1	**Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity and biodiversity of ecosystems at different scales**. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [*Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*]	Q	C	
	HS LS2-2	**Design an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions**. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [*Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.*]	Q	C	
	HS LS2-3	**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [*Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.*]	Q	C	

	HS LS2-4	**Develop a model to illustrate the role of photosynthesis, cellular respiration, and combustion of fossil fuels in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** [Clarification Statement: Examples of models could include simulations and mathematical models and the impact of human use of fossil fuels.] [*Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.*]	Q	C	I
	HS LS2-5	**Evaluate the claims, evidence, and reasoning that changing conditions results in new ecosystems, but stable conditions will maintain relatively consistent numbers and types of organisms.** [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting, invasive species, or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise, or human influence.]	Q	C	I

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3), (HS-LS2-4)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
- Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-4)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-1),(HS-LS2-4)

	HS-LS3	**Heredity: Inheritance and Variation of Traits**			
	HS LS3-1	**Explain the relationships about the role of DNA and chromosomes in passing on traits from parents to offspring.** [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*]	Q	C	
	HS LS3-2	**Explain that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]	Q	C	
	HS LS3-3	**Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population**. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability (Punnett squares) of traits as it relates to genetic and environmental factors in the expression of traits.] [*Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.*]	Q	C	

Disciplinary Core Ideas

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)*

LS3.B: Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

LS3.C: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)
- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)

	HS-LS4	**Biological Evolution: Unity and Diversity**			
	HS LS4-1	**Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence**. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]	Q	C	
	HS LS4-2	**Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*]	Q	C	
	HS LS4-3	**Construct an explanation and evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species**. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]	Q	C	I

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

LS4.B: Natural Selection

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3)
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

LS4.C: Adaptation

- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3)
- Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)
- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-3)
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-3)

	HS-LS5	**Human Influence in Life Science**			
	HS LS5-1	**Design and evaluate a solution for reducing the impacts of human activities on the environment and biodiversity**. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species. **Note: Solutions should not conflict with Catholic Church teachings**.]	Q	C	I
	HS LS5-2	**Explain and evaluate an ethical solution addressing the use of advanced biological research**. [Clarification Statement: Examples could include the use of stem cells, genetic engineering, abortion, euthanasia, and biological warfare. **Note: Solutions should not conflict with Catholic Church teachings.]**	Q	C	I

Disciplinary Core Ideas

LS5-A: Biodiversity and Humans

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(HS-LS5-1)*