



**CATHOLIC SCHOOLS OFFICE**  
**ARCHDIOCESE OF BOSTON**

**Curriculum Framework**

**Science and Engineering, Grades PreK-8**

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# PreK

## Intellectual and Dispositional Standards

1. Demonstrate an ability to ask questions about the natural world that surrounds them.
2. Make coherent observations about the natural world that surrounds them.
3. Engage in developmentally appropriate experimentation/play.
4. With guidance, demonstrate an ability to set up simple investigations, collect evidence/data/patterns, analyze evidence, and use evidence to explain an idea or developing understanding.
5. Identify or describe the way that senses and body parts are used to help meet needs and make sense of surroundings.
6. Demonstrate an initial awareness of the differences between/among natural phenomena and processes.
7. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
8. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
9. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

## Content, Knowledge, and Skills Standards

### Earth and Space Sciences

#### *Earth's Place in the Universe*

1. Demonstrate awareness that the Moon can be seen in the daytime and at night, and of the different apparent shapes of the Moon over a month. [PreK-ESS1-1(MA)]
2. Observe and use evidence to describe that the Sun is in different places in the sky during the day. [PreK-ESS1-2(MA)]

#### *Earth's Systems*

3. Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things. [PreK-ESS2-1(MA)]
4. Observe and classify non-living materials, natural and human made, in the local environment. [PreK-ESS2-2(MA)]
5. Explore and describe different places water is found in the local environment. [PreK-ESS2-3(MA)]
6. Use simple instruments to collect and record data on elements of daily weather, including sun or clouds, wind, snow or rain, and higher or lower temperature. [PreK-ESS2-4(MA)]
7. Describe how local weather changes from day to day and over the seasons and recognize patterns in those changes. [PreK-ESS2-5(MA)]
8. Provide examples of the impact of weather on living things. [PreK-ESS2-6(MA)]

### *Earth and Human Activity*

9. Engage in discussion and raise questions using examples about local resources (including soil and water) humans use to meet their needs. [PreK-ESS3-1(MA)]
10. Observe and discuss the impact of people’s activities on the local environment. [PreK-ESS3-2(MA)]

## **Life Science**

### *From Molecules to Organisms: Structures and Processes*

11. Compare, using descriptions and drawings, the external body parts of animals (including humans) and plants and explain functions of some of the observable body parts. [PreK-LS1-1(MA)]
12. Explain that most animals have five senses they use to gather information about the world around them. [PreK-LS1-2(MA)]
13. Use their five senses in their exploration and play to gather information. [PreK-LS1-3(MA)]

### *Ecosystems: Interactions, Energy, and Dynamics*

14. Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things. [PreK-LS2-1(MA)]
15. Using evidence from the local environment, explain how familiar plants and animals meet their needs where they live. [PreK-LS2-2(MA)]
16. Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs. [PreK-LS2-3(MA)]

### *Variation of Traits*

17. Use observations to explain that young plants and animals are like but not exactly like their parents. [PreK-LS3-1(MA)]
18. Use observations to recognize differences and similarities among themselves and their friends. [PreK-LS3-2(MA)]

## **Physical Science**

### *Matter and Its Interactions*

19. Raise questions and investigate the differences between liquids and solids and develop awareness that a liquid can become a solid and vice versa. [PreK-PS1-1(MA)]
20. Investigate natural and human-made objects to describe, compare, sort, and classify objects based on observable physical characteristics, uses, and whether something is manufactured or occurs in nature. [PreK-PS1-2(MA)]
21. Differentiate between the properties of an object and those of the material of which it is made. [PreK-PS1-3(MA)]
22. Recognize through investigation that physical objects and materials can change under different circumstances. [PreK-PS1-4(MA)]

### *Motion and Stability: Forces and Interactions*

23. Using evidence, discuss ideas about what is making something move the way it does and how some movements can be controlled. [PreK-PS2-1(MA)]
24. Through experience, develop awareness of factors that influence whether things stand or fall. [PreK-PS2-2(MA)]

*Waves and Their Applications in Technologies for Information Transfer*

25. Investigate sounds made by different objects and materials and discuss explanations about what is causing the sounds. Through play and investigations, identify ways to manipulate different objects and materials that make sound to change volume and pitch.  
[PreK-PS4-1(MA)]
26. Connect daily experiences and investigations to demonstrate the relationships between the size and shape of shadows, the objects creating the shadow, and the light source.  
[PreK-PS4-2(MA)]

# Kindergarten

## Intellectual and Dispositional Standards

1. Continue development of individual ability to set up simple investigations, collect evidence/data/patterns, analyze evidence, and use evidence to explain an idea.
2. Coherently communicate the kinds of investigations that emerge from developmentally appropriate experimentation and play.
3. With guidance, demonstrate an ability to design solutions to natural problems that occur in the classroom or at home.
4. With guidance, demonstrate an ability to apply knowledge taken from outside/other experiences to natural problems that occur in the classroom or at home.
5. Make quantitative observations about nature in order to identify naturally occurring changes.
6. Identify and describe reasons from the major features of the natural world for naturally occurring changes.
7. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
8. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
9. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

## Content, Knowledge, and Skills Standards

### Earth and Space Sciences

#### *Earth's Systems*

1. Use and share quantitative observations of local weather conditions to describe patterns over time. [K-ESS2-1]
2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment. [K-ESS2-2]

#### *Earth and Human Activity*

3. Obtain and use information about weather forecasting to prepare for, and respond to, different types of local weather. [K-ESS3-2]
4. Communicate solutions to reduce the amount of natural resources an individual uses. [K-ESS3-3]

### Life Science

#### *From Molecules to Organisms: Structures and Processes*

5. Observe and communicate that animals (including humans) and plants need food, water, and air to survive. Animals get food from plants or other animals. Plants make their own food and need light to live and grow. [K-LS1-1]
6. Recognize that all plants and animals grow and change over time. [K-LS1-2(MA)]

## **Physical Science**

### *Matter and Its Interactions*

7. Investigate and communicate the idea that different kinds of materials can be solid or liquid depending on temperature. [K-PS1-1(MA)]

### *Motion and Stability: Forces and interactions*

8. Compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [K-PS2-1]

### *Energy*

9. Make observations to determine that sunlight warms materials on Earth's surface. [K-PS3-1]
10. Use tools and materials to design and build a model of a structure that will reduce the warming effect of sunlight on an area. [K-PS3-2]

# First Grade

## Intellectual and Dispositional Standards

1. Demonstrate an ability to craft scientific explanations using evidence from a variety of sources.
2. Continue development of individual ability to experiment and investigate based on questions generated about the natural world.
3. Demonstrate an ability to analyze observations and data for the purposes of generating more accurate problem solutions.
4. Describe basic patterns of motion in the natural world.
5. Identify and describe seasonal patterns that occur on Earth; generate predictions about future patterns based on observed patterns.
6. Compare and contrast the behavior and appearance of different plant and animal types based on studying, observing, investigating natural patterns and processes.
7. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
8. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
9. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

## Content, Knowledge, and Skills Standards

### Earth and Space Sciences

#### *ESS1. Earth's Place in the Universe*

1. Use observations of the Sun, Moon, and stars to describe that each appears to rise in one part of the sky, appears to move across the sky, and appears to set. [1-ESS1-1]
2. Analyze provided data to identify relationships among seasonal patterns of change, including relative sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment. [1-ESS1-2]

### Life Science

#### *From Molecules to Organisms: Structures and Processes*

3. Use evidence to explain that (a) different animals use their body parts and senses in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air, and (b) plants have roots, stems, leaves, flowers, and fruits that are used to take in water, air, and other nutrients, and produce food for the plant. [1-LS1-1]
4. Obtain information to compare ways in which the behavior of different animal parents and their offspring help the offspring to survive. [1-LS1-2]

#### *Heredity: Inheritance and Variation of Traits*

5. Use information from observations (first-hand and from media) to identify similarities and differences among individual plants or animals of the same kind. [1-LS3-1]

## **Physical Science**

### *Waves and Their Applications in Technologies for Information Transfer*

6. Demonstrate that vibrating materials can make sound and that sound can make materials vibrate. [1-PS4-1]
7. Conduct an investigation to determine the effect of placing materials that allow light to pass through them, allow only some light through them, block all the light, or redirect light when put in the path of a beam of light. [1-PS4-3]
8. Use tools and materials to design and build a device that uses light or sound to send a signal over a distance. [1-PS4-4]

## **Technology/Engineering**

### *Engineering Design*

9. Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool. [K-2-ETS1-1]
10. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions. [K-2-ETS1-2]

## Second Grade

### Intellectual and Dispositional Standards

1. Demonstrate an independent ability to conduct investigations, to perform data analysis, to design problem solutions, and to argue using appropriate scientific academic language.
2. Identify and describe complex environments.
3. Demonstrate proficiency in observational skills in order to appropriately classify materials based on property and function.
4. Explain the relationship between individual parts and more complex systems (how parts relate to a whole and vice versa).
5. Demonstrate an independent ability to test materials and to collect data in order to determine the function of various materials.
6. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
7. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
8. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### Content, Knowledge, and Skills Standards

#### Earth and Space Sciences

##### *Earth's Systems*

1. Investigate and compare the effectiveness of multiple solutions designed to slow or prevent wind or water from changing the shape of the land. [2-ESS2-1]
2. Map the shapes and types of landforms and bodies of water in an area. [2-ESS2-2]
3. Use examples obtained from informational sources to explain that water is found in the ocean, rivers and streams, lakes and ponds, and may be solid or liquid. [2-ESS2-3]
4. Observe how blowing wind and flowing water can move Earth materials from one place to another and change the shape of a landform. [2-ESS2-4(MA)]

#### Life Science

##### *Ecosystems: Interactions, Energy, and Dynamics*

5. Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live. [2-LS2-3(MA)]

##### *Biological Evolution: Unity and Diversity*

6. Use texts, media, or local environments to observe and compare (a) different kinds of living things in an area, and (b) differences in the kinds of living things living in different types of areas. [2-LS4-1]

## **Physical Science**

### *Matter and Its Interactions*

7. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency. [2-PS1-1]
8. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose. [2-PS1-2]
9. Analyze a variety of evidence to conclude that when a chunk of material is cut or broken into pieces, each piece is still the same material and, however small each piece is, has weight. Show that the material properties of a small set of pieces do not change when the pieces are used to build larger objects. [2-PS1-3]
10. Construct an argument with evidence that some changes to materials caused by heating or cooling can be reversed and some cannot. [2-PS1-4]

### *Energy*

11. Design and conduct an experiment to show the effects of friction on the relative temperature and speed of objects that rub against each other. [2-PS3-1(MA)]

## **Technology/Engineering**

### *Engineering Design*

12. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs. [K-2-ETS1-3]

## **Third Grade**

### **Intellectual and Dispositional Standards**

1. Demonstrate an independent ability to obtain, record, chart, and analyze data in order to study the environment.
2. Identify and implement practices to study the interactions between humans and earth systems, humans and the environment, and humans and the designed world.
3. Analyze weather patterns and develop evidence-based inferences about humans' influence on and opportunity to impact weather-related events.
4. Develop evidence-based inferences about the interactions between and influence of the environment and human traits/characteristics.
5. Use the engineering design process to identify a problem and design solutions that enhance humans' interactions with their surroundings.
6. Develop evidence-based inferences about the interactions between objects and forces.
7. Provide evidence to support arguments about the influence of humans on nature and nature on the human experience.
8. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
9. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
10. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### **Content, Knowledge, and Skills Standards**

#### **Earth and Space Sciences**

##### *Earth's Systems*

1. Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area. [3-ESS2-1]
2. Obtain and summarize information about the climate of different regions of the world to illustrate that typical weather conditions over a year vary by region. [3-ESS2-2]

##### *Earth and Human Activity*

3. Evaluate the merit of a design solution that reduces the damage caused by weather. [3-ESS3-1]

#### **Life Science**

##### *From Molecules to Organisms: Structures and Processes*

4. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen. [3-LS1-1]

### *Heredity: Inheritance and Variation of Traits*

5. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms. [3-LS3-1]
6. Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. [3-LS3-2]

### *Biological Evolution: Unity and Diversity*

7. Use fossils to describe types of organisms and their environments that existed long ago and compare those to living organisms and their environments. Recognize that most kinds of plants and animals that once lived on Earth are no longer found anywhere. [3-LS4-1]
8. Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. [3-LS4-2]
9. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [3-LS4-3]
10. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [3-LS4-4]

## **Physical Science**

### *Motion and Stability: Forces and Interactions*

11. Provide evidence to explain the effect of multiple forces, including friction, on an object. Include balanced forces that do not change the motion of the object and unbalanced forces that do change the motion of the object. [3-PS2-1]
12. Conduct an investigation to determine the nature of the forces between two magnets based on their orientations and distance relative to each other. [3-PS2-3]
13. Define a simple design problem that can be solved by using interactions between magnets. [3-PS2-4]

## **Technology/Engineering**

### *Engineering Design*

14. Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet. [3-5-ETS1-1]
15. Generate several possible solutions to a given design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem. [3-5-ETS1-2]
16. Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution. [3.3-5-ETS1-4(MA)]

## **Fourth Grade**

### **Intellectual and Dispositional Standards**

1. Use evidence and skills of scientific investigation/argumentation to interpret patterns related to the transfer of matter and energy on Earth in physical interactions and in organisms.
2. Compare and contrast the motion, transfer, and conversion of energy based on objects existing in different physical contexts.
3. Provide evidence to support arguments about patterns of change over time related to the deposition and erosion of landscape formations.
4. Describe the internal and external structures that support animal life, growth, behavior, and reproduction.
5. Use the engineering design process to build, test, and redesign prototypes to fit specific purposes or solve specific problems.
6. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
7. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
8. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### **Content, Knowledge, and Skills Standards**

#### **Earth and Space Sciences**

##### *Earth's Place in the Universe*

1. Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time. [4-ESS1-1]

##### *Earth's Systems*

2. Make observations and collect data to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering and moved around through erosion. [4-ESS2-1]
3. Analyze and interpret maps of Earth's mountain ranges, deep ocean trenches, volcanoes, and earthquake epicenters to describe patterns of these features and their locations relative to boundaries between continents and oceans. [4-ESS2-2]

##### *Earth and Human Activity*

4. Obtain information to describe that energy and fuels humans use are derived from natural resources and that some energy and fuel sources are renewable and some are not. [4-ESS3-1]
5. Evaluate different solutions to reduce the impacts of a natural event such as an earthquake, blizzard, or flood on humans. [4-ESS3-2]

## **Life Science**

### *From Molecules to Organisms: Structures and Processes*

6. Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction. [4-LS1-1]

## **Physical Science**

### *Energy*

7. Use evidence to construct an explanation relating the speed of an object to the energy of that object. [4-PS3-1]
8. Make observations to show that energy can be transferred from place to place by sound, light, heat, and electric currents. [4-PS3-2]
9. Ask questions and predict outcomes about the changes in energy that occur when objects collide. [4-PS3-3]
10. Apply scientific principles of energy and motion to test and refine a device that converts kinetic energy to electrical energy or uses stored energy to cause motion or produce light or sound. [4-PS3-4]

### *Waves and Their Applications in Technologies for Information Transfer*

11. Develop a model of a simple mechanical wave (including sound) to communicate that waves (a) are regular patterns of motion along which energy travels and (b) can cause objects to move. [4-PS4-1]
12. Develop a model to describe that light must reflect off an object and enter the eye for the object to be seen. [4-PS4-2]
13. Develop and compare multiple ways to transfer information through encoding, sending, receiving, and decoding a pattern. [4-PS4-3]

## **Technology/Engineering**

### *Engineering Design*

14. Plan and carry out tests of one or more design features of a given model or prototype in which variables are controlled and failure points are considered to identify which features need to be improved. Apply the results of tests to redesign a model or prototype. [3-5-ETS1-3]
15. Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem. [4.3-5-ETS1-5(MA)]

# Fifth Grade

## Intellectual and Dispositional Standards

1. Explain relationships and interactions among observable components of different systems by modeling, providing evidence to support arguments, and obtaining/displaying appropriate data.
2. Provide evidence to support scientific arguments about the extent to which objects and organisms are interconnected and to which animals, plants, and their environments are connected to/influence each other.
3. Identify and describe the relationship between Earth and other nearby objects in the solar system, as well as the impact of those relationships on natural patterns on Earth.
4. Use evidence and skills of scientific investigation to draw conclusions about the cycling of water and human practices that affect water and other natural processes.
5. Compare and contrast the connections and relationships between/among observable components of different systems in natural and designed environments through scientific description, analysis, and modeling.
6. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
7. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
8. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

## Content, Knowledge, and Skills Standards

### Earth and Space Sciences

#### *Earth's Place in the Universe*

1. Use observations, first-hand and from various media, to argue that the Sun is a star that appears larger and brighter than other stars because it is closer to Earth. [5-ESS1-1]
2. Use a model to communicate Earth's relationship to the Sun, Moon, and other stars that explain (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a month, and over a year. [5-ESS1-2]

#### *Earth's Systems*

3. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation. [5-ESS2-1]
4. Describe and graph the relative amounts of salt water in the ocean; fresh water in lakes, rivers, and groundwater; and fresh water frozen in glaciers and polar ice caps to provide evidence about the availability of fresh water in Earth's biosphere. [5-ESS2-2]

### *Earth and Human Activity*

5. Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. [5-ESS3-1]
6. Test a simple system designed to filter particulates out of water and propose one change to the design to improve it. [5-ESS3-2(MA)]

## **Life Science**

### *From Molecules to Organisms: Structures and Processes*

7. Ask testable questions about the process by which plants use air, water, and energy from sunlight to produce sugars and plant materials needed for growth and reproduction. [5-LS1-1]

### *Ecosystems: Interactions, Energy, and Dynamics*

8. Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment to (a) show that plants produce sugars and plant materials, (b) show that animals can eat plants and/or other animals for food, and (c) show that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil. [5-LS2-1]
9. Compare at least two designs for a composteur to determine which is most likely to encourage decomposition of materials. [5-LS2-2(MA)]

## **Physical Science**

### *Matter and Its Interactions*

10. Use a particle model of matter to explain common phenomena involving gases, and phase changes between gas and liquid and between liquid and solid. [5-PS1-1]
11. Measure and graph the weights (masses) of substances before and after a reaction or phase change to provide evidence that regardless of the type of change that occurs when heating, cooling, or combining substances, the total weight (mass) of matter is conserved. [5-PS1-2]
12. Make observations and measurements of substances to describe characteristic properties of each, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [5-PS1-3]
13. Conduct an experiment to determine whether the mixing of two or more substances results in new substances with new properties (a chemical reaction) or not (a mixture). [5-PS1-4]

### *Motion and Stability: Forces and Interactions*

14. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. [5-PS2-1]

### *Energy*

15. Use a model to describe that the food animals digest (a) contains energy that was once energy from the Sun, and (b) provides energy and nutrients for life processes, including body repair, growth, motion, body warmth, and reproduction. [5-PS3-1]

## **Technology/Engineering**

### *Technological Systems*

16. Use informational text to provide examples of improvements to existing technologies (innovations) and the development of new technologies (inventions). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants. [5.3-5-ETS3-1(MA)]
17. Use sketches or drawings to show how each part of a product or device relates to other parts in the product or device. [5.3-5-ETS3-2(MA)]

## Sixth Grade

### Intellectual and Dispositional Standards

1. Explain the relationship between the structure and function of phenomena in the world making claims grounded in content-specific, integrated scientific investigation and argumentation.
2. Use the engineering design process to design and solve a problem that highlights the relationship between the structure and function of phenomena in the world.
3. Analyze Earth's features and processes, the role of cells and anatomy, and the properties of materials and waves in order to draw evidence-based conclusions about the relationship between macroscopic and microscopic environments.
4. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
5. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
6. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### Content, Knowledge, and Skills Standards

#### Earth and Space Sciences

##### *Earth's Place in the Universe*

1. Develop and use a model of the Earth-Sun-Moon system to explain the causes of lunar phases and eclipses of the Sun and Moon. [MS-ESS1-1a]
2. Analyze and interpret rock layers and index fossils to determine the relative ages of rock formations that result from processes occurring over long periods of time. [MS-ESS1-4]
3. Use graphical displays to illustrate that Earth and its solar system are one of many in the Milky Way galaxy, which is one of billions of galaxies in the universe. [6.MS-ESS1-5(MA)]

##### *Earth's Systems*

4. Analyze and interpret maps showing the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence that Earth's plates have moved great distances, collided, and spread apart. [MS-ESS2-3]

#### Life Science

##### *From Molecules to Organisms: Structures and Processes*

5. Provide evidence that all organisms (unicellular and multicellular) are made of cells. [MS-LS1-1]
6. Develop and use a model to describe how parts of cells contribute to the cellular functions of obtaining food, water, and other nutrients from its environment, disposing of wastes, and providing energy for cellular processes. [MS-LS1-2]
7. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life. [MS-LS1-3]

### *Biological Evolution: Unity and Diversity*

8. Analyze and interpret evidence from the fossil record to describe organisms and their environment, extinctions, and changes to life forms throughout the history of Earth. [MS-LS4-1]
9. Construct an argument using anatomical structures to support evolutionary relationships among and between fossil organisms and modern organisms. [MS-LS4-2]

## **Physical Science**

### *Matter and Its Interactions*

10. Plan and conduct an experiment involving exothermic and endothermic chemical reactions to measure and describe the release or absorption of thermal energy. [MS-PS1-6]
11. Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials. [6.MS-PS1-7(MA)]
12. Conduct an experiment to show that many materials are mixtures of pure substances that can be separated by physical means into their component pure substances. [6.MS-PS1-8(MA)]

### *Motion and Stability: Forces and Interactions*

13. Use evidence to support the claim that gravitational forces between objects are attractive and are only noticeable when one or both of the objects have a very large mass. [MS-PS2-4]

### *Waves and Their Applications in Technologies for Information Transfer*

14. Use diagrams of a simple wave to explain that (a) a wave has a repeating pattern with a specific amplitude, frequency, and wavelength, and (b) the amplitude of a wave is related to the energy of the wave. [MS-PS4-1]
15. Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials. [MS-PS4-2]
16. Present qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses representing 0s and 1s) can be used to encode and transmit information. [MS-PS4-3]

## **Technology/Engineering**

### *Engineering Design*

17. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions. [MS-ETS1-1]
18. Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations. [6.MS-ETS1-5(MA)]
19. Communicate a design solution to an intended user, including design features and limitations of the solution. [6.MS-ETS1-6(MA)]

### *Materials, Tools, and Manufacturing*

20. Analyze and compare properties of metals, plastics, wood, and ceramics, including flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point. [6.MS-ETS2-1(MA)]

21. Given a design task, select appropriate materials based on specific properties needed in the construction of a solution. [6.MS-ETS2-2(MA)]
22. Choose and safely use appropriate measuring tools, hand tools, fasteners, and common hand-held power tools used to construct a prototype. [6.MS-ETS2-3(MA)]

## Seventh Grade

### Intellectual and Dispositional Standards

1. Explain the underlying, complex, and interactive dynamics of systems and cycles making claims grounded in content-specific, integrated scientific investigation and argumentation.
2. Compare and contrast systems and cycles that are and that are not directly observable/experienced in order to develop the capacity to differentiate between abstract and concrete scientific perspective-taking.
3. Use the engineering design process to design and solve a problem that highlights knowledge and understanding of complex, interactive systems and cycles.
4. Analyze plate tectonics, interactions of humans and Earth processes, organism systems to support and propagate life, ecosystem dynamics, motion and energy systems, and key technological systems used by society in order to draw evidence-based conclusions about the interaction between natural and designed systems and cycles.
5. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
6. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
7. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### Content, Knowledge, and Skills Standards

#### Earth and Space Sciences

##### *Earth's Systems*

1. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from local to global in size. [MS-ESS2-2]
2. Develop a model to explain how the energy of the Sun and Earth's gravity drive the cycling of water, including changes of state, as it moves through multiple pathways in Earth's hydrosphere. [MS-ESS2-4]

##### *Earth and Human Activity*

3. Obtain and communicate information on how data from past geologic events are analyzed for patterns and used to forecast the location and likelihood of future catastrophic events. [MS-ESS3-2]
4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment. [MS-ESS3-4]

## Life Science

### *From Molecules to Organisms: Structures and Processes*

5. Construct an explanation based on evidence for how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants. [MS-LS1-4]

### *Ecosystems: Interactions, Energy, and Dynamics*

6. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the size of populations in an ecosystem. [MS-LS2-1]
7. Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems. [MS-LS2-2]
8. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes. [MS-LS2-3]
9. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. [MS-LS2-4]
10. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design. [MS-LS2-5]
11. Explain how changes to the biodiversity of an ecosystem—the variety of species found in the ecosystem—may limit the availability of resources humans use. [7.MS-LS2-6(MA)]

## Physical Science

### *Motion and Stability: Forces and Interactions*

12. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces. [MS-PS2-3]
13. Use scientific evidence to argue that fields exist between objects with mass, between magnetic objects, and between electrically charged objects that exert force on each other even though the objects are not in contact. [MS-PS2-5]

### *Energy*

14. Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object. [MS-PS3-1]
15. Develop a model to describe the relationship between the relative positions of objects interacting at a distance and their relative potential energy in the system. [MS-PS3-2]
16. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer. [MS-PS3-3]
17. Conduct an investigation to determine the relationships among the energy transferred, how well the type of matter retains or radiates heat, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [MS-PS3-4]
18. Present evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [MS-PS3-5]
19. Use a model to explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection, conduction, and radiation. [7.MS-PS3-6(MA)]

20. Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another. [7.MS-PS3-7(MA)]

## **Technology/Engineering**

### *Engineering Design*

21. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem. Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost, may affect the function or effectiveness of the solution. [MS-ETS1-2]
22. Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose. [MS-ETS1-4]
23. Construct a prototype of a solution to a given design problem. [7.MS-ETS1-7(MA)]

### *Technological Systems*

24. Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage. [7.MS-ETS3-1(MA)]
25. Compare the benefits and drawbacks of different communication systems. [7.MS-ETS3-2(MA)]
26. Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle, including structural, propulsion, guidance, suspension, and control subsystems. [7.MS-ETS3-3(MA)]
27. Show how the components of a structural system work together to serve a structural function. Provide examples of physical structures and relate their design to their intended use. [7.MS-ETS3-4(MA)]
28. Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system. [7.MS-ETS3-5(MA)]

## **Eighth Grade**

### **Intellectual and Dispositional Standards**

1. Explain the causes of complex phenomena and systems making claims grounded in content-specific, integrated scientific investigation and argumentation.
2. Compare and contrast the causes and effects of key natural phenomena and designed processes in order to develop the capacity to better explain natural/designed patterns and make predictions about future events.
3. Use the engineering design process to design and solve a problem that highlights knowledge and understanding of the causes and effects of complex phenomena and systems.
4. Analyze the causes of seasons and tides, the causes of plate tectonics, the causes of weather/climate, the role of genetics in reproduction/heredity, and the interaction of atoms and molecules in order to draw evidence-based conclusions about the substances that make up the known universe and how materials change.
5. Analyze phenomena for evidence of causes and processes that cannot be seen in order to draw evidence-based conclusions about those phenomena.
6. Through application of content learned during this grade, provide evidence that all eight Science and Engineering Practices appropriate for this grade level ([State Frameworks, Appendix I, pp. 106-121](#)) have been developed.
7. Through application of content learned during this grade, provide evidence of a developing appreciation of the relationships, elements, underlying order, harmony, and meaning of God's creation.
8. Through application of content learned during this grade, provide evidence of a developing understanding that the use of scientific investigation and argumentation can be directed toward the preservation and conservation of the creation God has given us.

### **Content, Knowledge, and Skills Standards**

#### **Earth and Space Sciences**

##### *Earth's Place in the Universe*

1. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. [MS-ESS1-1b]
2. Explain the role of gravity in ocean tides, the orbital motions of planets, their moons, and asteroids in the solar system. [MS-ESS1-2]

##### *Earth's Systems*

3. Use a model to illustrate that energy from Earth's interior drives convection that cycles Earth's crust, leading to melting, crystallization, weathering, and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building, and active volcanic chains. [MS-ESS2-1]
4. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather. [MS-ESS2-5]
5. Describe how interactions involving the ocean affect weather and climate on a regional scale, including the influence of the ocean temperature as mediated by energy input from

the Sun and energy loss due to evaporation or redistribution via ocean currents. [MS-ESS2-6]

#### *Earth and Human Activity*

6. Analyze and interpret data to explain that the Earth's mineral and fossil fuel resources are unevenly distributed as a result of geologic processes. [MS-ESS3-1]
7. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century. [MS-ESS3-5]

## **Life Science**

### *From Molecules to Organisms: Structures and Processes*

8. Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms. [MS-LS1-5]
9. Use informational text to describe that food molecules, including carbohydrates, proteins, and fats, are broken down and rearranged through chemical reactions forming new molecules that support cell growth and/or release of energy. [MS-LS1-7]

### *Heredity: Inheritance and Variation of Traits*

10. Develop and use a model to describe that structural changes to genes (mutations) may or may not result in changes to proteins, and if there are changes to proteins there may be harmful, beneficial, or neutral changes to traits. [MS-LS3-1]
11. Construct an argument based on evidence for how asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Compare and contrast advantages and disadvantages of asexual and sexual reproduction. [MS-LS3-2]
12. Communicate through writing and in diagrams that chromosomes contain many distinct genes and that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of an individual. [8.MS-LS3-3(MA)]
13. Develop and use a model to show that sexually reproducing organisms have two of each chromosome in their cell nuclei, and hence two variants (alleles) of each gene that can be the same or different from each other, with one random assortment of each chromosome passed down to offspring from both parents. [8.MS-LS3-4(MA)]

### *Biological Evolution: Unity and Diversity*

14. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals' likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations. [MS-LS4-4]
15. Synthesize and communicate information about artificial selection, or the ways in which humans have changed the inheritance of desired traits in organisms. [MS-LS4-5]

## **Physical Science**

### *Matter and Its Interactions*

16. Develop a model to describe that (a) atoms combine in a multitude of ways to produce pure substances which make up all of the living and nonliving things that we encounter, (b) atoms form molecules and compounds that range in size from two to thousands of atoms, and (c) mixtures are composed of different proportions of pure substances. [MS-PS1-1]

17. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [MS-PS1-2]
18. Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed. [MS-PS1-4]
19. Use a model to explain that atoms are rearranged during a chemical reaction to form new substances with new properties. Explain that the atoms present in the reactants are all present in the products and thus the total number of atoms is conserved. [MS-PS1-5]

*Motion and Stability: Forces and Interactions*

20. Develop a model that demonstrates Newton's third law involving the motion of two colliding objects. [MS-PS2-1]
21. Provide evidence that the change in an object's speed depends on the sum of the forces on the object (the net force) and the mass of the object. [MS-PS2-2]

## **Technology/Engineering**

*Materials, Tools, and Manufacturing*

22. Use informational text to illustrate that materials maintain their composition under various kinds of physical processing; however, some material properties may change if a process changes the particulate structure of a material. [8.MS-ETS2-4(MA)]
23. Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes. [8.MS-ETS2-5(MA)]