

Grade 5 Science-Technology-Engineering

Introduction: The diocesan Science-Technology-Engineering curriculum guidelines are adapted from the *Next Generation Science Standards* (NGSS) <http://www.nextgenscience.org/> and are based on the *2016 MA Science & Technology/Engineering Framework* (MA STE) [available: <http://www.doe.mass.edu/frameworks/current.html> and in separate sections along with other resources at: <http://www.doe.mass.edu/stem/review.html>] These resources should be explored since they include a wealth of information beyond the standards. The diocesan guidelines use the same numbering system for the standards in order to facilitate searches for lessons and other resources. The order of the standards does not imply a recommended instructional sequence. “Common Core Connections” from NGSS are included for grades K-5 to suggest ways to include science in other subjects (and vice versa.) “Assessment boundaries” indicate what may be included on future MCAS tests and are included here since they frequently offer further clarification of the performance expectations at that level. “Not included from NGSS”, “Clarification statements” and the set of standards themselves are not intended to be restrictive in any way. A standard followed by an asterisk “*” indicates an engineering design practice.

Grades 3–5: Overview of Science and Engineering Practices

Upper elementary is a critical time to engage students in the science and engineering practices. Students form key identities with, or against, science and engineering as they leave elementary school that can shape their relationship to science in later education, and even postsecondary and career choices later in life. Students must be given opportunities to develop the skills necessary for a meaningful progression of development in order to engage in the scientific and technical reasoning so critical to success in civic life, postsecondary education, and careers. Inclusion of science and engineering practices in standards only speaks to the types of performance students should be able to demonstrate at the end of instruction at a particular grade; the standards do not limit what educators and students should or can be engaged in through a well-rounded curriculum.

Standards for grades 3 through 5 integrate all eight science and engineering practices. Some examples of specific skills students should develop in these grades include:

1. Ask questions and predict outcomes about the changes in energy when objects collide; distinguish between scientific (testable) and non-scientific (non-testable) questions; define a simple design problem, including criteria for success and constraints on materials or time.
2. Use graphical representations to show differences in organisms’ life cycles; develop a model of a wave to communicate wave features; use a particulate model of matter to explain phase changes; identify limitations of models; use a model to test cause and effect relationships.
3. Conduct an investigation to determine the nature of forces between magnets; make observations and collect data about the effects of mechanical weathering; conduct an experiment on mixing of substances; evaluate appropriate methods for collecting data; make predictions about what would happen if a variable changes.
4. Use graphs and tables of weather data to describe and predict typical weather during a season; analyze and interpret maps of Earth’s physical features; use data to evaluate and refine design solutions.
5. Graph and describe the amounts and percentages of fresh and salt water in various reservoirs; measure and graph weights of substances before and after a chemical reaction.
6. Use evidence to explain how variations among individuals can provide advantages in survival and reproduction; provide evidence to explain the effect of multiple forces on the motion of an object; test and refine a simple system designed to filter impurities out of water.
7. Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction; distinguish among facts, reasoned judgment based on data, and speculation in an argument.
8. Obtain and summarize information about the climate of different regions; gather information on possible solutions to a given design problem; obtain information about renewable and nonrenewable energy sources.

While presented as distinct skill sets, the eight practices intentionally overlap and interconnect. Skills such as those outlined above should be reflected in curricula and instruction that engage students in an integrated use of the practices.

Grade 5 Focus - Connections and Relationships in Systems: In grade 5, students model, provide evidence to support arguments, and obtain and display data about relationships and interactions among observable components of different systems. By studying systems, grade 5 students learn that objects and organisms do not exist in isolation and that animals, plants and their environments are connected to, interact with, and are influenced by each other. They study the relationships between Earth and other nearby objects in the solar system and the impact of those relationships on patterns of events as seen from Earth. They learn about the relationship among elements of Earth's systems through the cycling of water and human practices and processes with Earth's resources. They also learn about the connections and relationships among plants and animals, and the ecosystems within which they live, to show how matter and energy are cycled through these (building on the theme of grade 4). An ability to describe, analyze, and model connections and relationships of observable components of different systems is key to understanding the natural and designed world.

Grade 5: Earth and Space Sciences

ESS1. Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. 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.

Assessment Boundary: Other factors that affect apparent brightness (such as stellar masses, age, or stage) are not expected in state assessment.

5-ESS1-2. 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.

Clarification Statement: Models should illustrate that the Earth, Sun, and Moon are spheres; include orbits of the Earth around the Sun and of the Moon around Earth; and demonstrate Earth's rotation about its axis.

Assessment Boundary: Causes of lunar phases or seasons, or use of Earth's tilt are not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1) **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1) **RI.5.8** Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1) **W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-ESS1-1) **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)

Mathematics – MP.2 Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2) **MP.4** Model with mathematics. (5-ESS1-1),(5-ESS1-2) **5.NBT.A.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1) **5.G.A.2** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2)

ESS2. Earth's Systems

5-ESS2-1. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation.

Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.

5-ESS2-2. 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.

Assessment Boundary: Inclusion of the atmosphere is not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS2-2) **W.5.8** Recall relevant information from

experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2) **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2) **Mathematics – MP.2** Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2) **MP.4** Model with mathematics. (5-ESS2-1),(5-ESS2-2) **5.G.A.2** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

ESS3. Earth and Human Activity

5-ESS3-1. 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.

Clarification Statement: Examples of changed practices or processes include treating sewage, reducing the amounts of materials used, capturing polluting emissions from factories or power plants, and preventing runoff from agricultural activities.

Assessment Boundary: Climate change or social science aspects of practices such as regulation or policy are not expected in state assessment.

5-ESS3-2(MA). Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.*

Common Core Connections: ELA/Literacy – RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1) **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1) **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1) **Mathematics – MP.2** Reason abstractly and quantitatively. (5-ESS3-1) **MP.4** Model with mathematics. (5-ESS3-1)

Grade 5: Life Science

LS1. From Molecules to Organisms: Structures and Processes

5-LS1-1. 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.

Assessment Boundary: The chemical formula or molecular details about the process of photosynthesis are not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1) **W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1) **Mathematics – MP.2** Reason abstractly and quantitatively. (5-LS1-1) **MP.4** Model with mathematics. (5-LS1-1) **MP.5** Use appropriate tools strategically. (5-LS1-1) **5.MD.A.1** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1)

LS2. Ecosystems: Interactions, Energy, and Dynamics

5-LS2-1. 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.

Clarification Statement: Emphasis is on matter moving throughout the ecosystem.

Assessment Boundary: Molecular explanations, or distinctions among primary, secondary, and tertiary consumers, are not expected in state assessment.

5-LS2-2(MA). Compare at least two designs for a composter to determine which is most likely to encourage decomposition of materials.*

Clarification Statement: Measures or evidence of decomposition should be on qualitative descriptions or comparisons.

Common Core Connections: ELA/Literacy – RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-LS2-1) **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1) **Mathematics – MP.2** Reason abstractly and quantitatively. (5-LS2-1) **MP.4** Model with mathematics. (5-LS2-1)

Grade 5: Physical Science

PS1. Matter and Its Interactions

5-PS1-1. Use a particle model of matter to explain common phenomena involving gases, and phase changes between gas and liquid and between liquid and solid.

Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a balloon, compressing air in a syringe, and evaporating water from a salt water solution.

Assessment Boundary: Atomic-scale mechanisms of evaporation and condensation or defining unseen particles are not expected in state assessment.

5-PS1-2. 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.

Clarification Statement: Assume that reactions with any gas production are conducted in a closed system.

Assessment Boundary: Distinguishing mass and weight is not expected in state assessment.

5-PS1-3. 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.

Clarification Statements: Emphasis is on describing how each substance has a unique set of properties. Examples of substances could include baking soda and other powders, metals, minerals, and liquids.

Assessment Boundary: Density, distinguishing mass and weight, or specific tests or procedures are not expected in state assessment.

5-PS1-4. 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).

Common Core Connections: **ELA/Literacy – RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1) **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2),(5-PS1-3),(5-PS1-4) **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-2),(5-PS1-3),(5-PS1-4) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2),(5-PS1-3),(5-PS1-4) **Mathematics – MP.2** Reason abstractly and quantitatively. (5-PS1-1),(5-PS1-2),(5-PS1-3) **MP.4** Model with mathematics. (5-PS1-1),(5-PS1-2),(5-PS1-3) **MP.5** Use appropriate tools strategically. (5-PS1-2),(5-PS1-3) **5.NBT.A.1** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1) **5.NF.B.7** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1) **5.MD.A.1** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. (5-PS1-2) **5.MD.C.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1) **5.MD.C.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)

PS2. Motion and Stability: Forces and Interactions

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

Assessment Boundary: Mathematical representations of gravitational force are not expected in state assessment.

Common Core Connections: **ELA/Literacy – RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1) **W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1)

PS3. Energy

5-PS3-1. 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.

Clarification Statement: Examples of models could include diagrams and flow charts.

Assessment Boundary: Details of cellular respiration, ATP, or molecular details of the process of photosynthesis or respiration are not expected in state assessment.

Common Core Connections: **ELA/Literacy – RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS3- 1) **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5- PS3-1)

Grade 5: Technology/Engineering

ETS3. Technological Systems

5.3-5-ETS3-1(MA). 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-ETS3-2(MA). Use sketches or drawings to show how each part of a product or device relates to other parts in the product or device.*

Common Core Connections: **ELA/Literacy – RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. **Mathematics – MP.2** Reason abstractly and quantitatively. **MP.5** Use appropriate tools strategically.