Grade 3 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 3 Focus - Human Interactions: In grade 3, students develop and sharpen their skills at obtaining, recording and charting, and analyzing data in order to study their environment. They use these practices to study the interactions between humans and earth systems, humans and the environment, and humans and the designed world. They learn that these entities not only interact but influence behaviors, reactions, and traits of organisms. Grade 3 students analyze weather patterns and consider humans' influence and opportunity to impact weather-related events. In life science they study the interactions between and influence of the environment and human traits and characteristics. They use the engineering design process to identify a problem and design solutions that enhance humans' interactions with their surroundings and to meet their needs. Students consider the interactions and consequent reactions between objects and forces, including forces that are balanced or not. Students reason and provide evidence to support arguments for the influence of humans on nature and nature on human experience.

Grade 3: Earth and Space Sciences

ESS2. Earth's Systems

Students who demonstrate understanding can:

3-ESS2-1. Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area.

Clarification Statements: Examples of weather data could include temperature, amount and type of precipitation (e.g., rain, snow), wind direction, and wind speed. Graphical displays should focus on pictographs and bar graphs.

3-ESS2-2. 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.

Clarification Statement: Examples of information can include climate data (average temperature, average precipitation, average wind speed) or comparative descriptions of seasonal weather for different regions.

Assessment Boundary: An understanding of climate change is not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2-2) **RI.3.9** Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) **W.3.9** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3- ESS2-2) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2) **MP.4** Model with mathematics. (3-ESS2-1),(3-ESS2-2) **MP.5** Use appropriate tools strategically. (3-ESS2-1) **3.MD.A.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1) **3.MD.B.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)

ESS3. Earth and Human Activity

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

Clarification Statement: Examples of design solutions to reduce weather-related damage could include a barrier to prevent flooding, a wind-resistant roof, and a lightning rod.

Common Core Connections: ELA/Literacy – W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1) **W.3.7** Conduct short research projects that build knowledge about a topic. (3-ESS3-1) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-ESS3-1) **MP.4** Model with mathematics. (3-ESS3-1)

Grade 3: Life Science

LS1. From Molecules to Organisms: Structures and Processes

3-LS1-1. 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.

Clarification Statements: Examples can include different ways plants and animals begin (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce a new part), reproduce (e.g., develop seeds, root runners, mate and lay eggs that hatch), and die (e.g., length of life). Plant life cycles should focus on those of flowering plants. Describing variation in organism life cycles should focus on comparisons of the general stages of each, not specifics.

Assessment Boundary: Detailed descriptions of any one organism's cycle, the differences of "complete metamorphosis" and "incomplete metamorphosis," or details of human reproduction are not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). (3-LS1-1) **SL.3.5** Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. (3-LS1-1) **Mathematics – MP.4** Model with mathematics. (3-LS1-1) **3.NBT** Number and Operations in Base Ten (3-LS1-1) **3.NF** Number and Operations—Fractions (3-LS1-1)

LS2. Ecosystems: Interactions, Energy, and Dynamics

Not included from NGSS: 3-LS2-1. Construct an argument that some animals form groups that help members survive.

LS3. Heredity: Inheritance and Variation of Traits

3-LS3-1. 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.

Clarification Statements: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Focus should be on non-human examples.

Assessment Boundary: Genetic mechanisms of inheritance or prediction of traits are not expected in state assessment.

3-LS3-2. 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.

Clarification Statements: Examples of the environment affecting a characteristic could include normally tall plants stunted because they were grown with insufficient water or light, a lizard missing a tail due to a predator, and a pet dog becoming overweight because it is given too much food and little exercise. Focus should be on non-human examples.

Common Core Connections: ELA/Literacy – RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2) **RI.3.2** Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1),(3-LS3-2) **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),(3-LS3-2) **W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1),(3-LS3-2) **SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3- LS3-1),(3-LS3-2) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-LS3-1),(3-LS3-2) **MP.4** Model with mathematics. (3-LS3-1),(3-LS3-2) **3.MD.B.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-1),(3-LS3-2)

LS4. Biological Evolution: Unity and Diversity

3-LS4-1. 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.

Clarification Statement: Comparisons should focus on physical or observable features.

Assessment Boundary: Identification of specific fossils or specific present-day plants and animals, dynamic processes, or genetics are not expected in state assessment.

3-LS4-2. 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.

Clarification Statements: Examples can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer, and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to produce offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive.

Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.

3-LS4-4. 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.

Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.

3-LS4-5(MA). Provide evidence to support a claim that the survival of a population is dependent upon reproduction.

Assessment Boundary: Details of reproduction are not expected in state assessment.

Common Core Connections: ELA/Literacy – RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-1),(3-LS4-2),(3-LS4-3) (3-LS4-4) **RI.3.2** Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3LS4-4) **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4) **W.3.1** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS4-1),(3-LS4-3),(3-LS4-4) **W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4) **W.3.9** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1) **SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS4-2),(3-LS4-3),(3-LS4-4) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4) **MP.4** Model with mathematics. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4) **MP.5** Use appropriate tools strategically. (3-LS4-1) **3.MD.B.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. (3-LS4-2),(3-LS4-3) **3.MD.B.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS4-1)

Grade 3: Physical Science

PS2. Motion and Stability: Forces and Interactions

3-PS2-1. 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.

Clarification Statements: Descriptions of force magnitude should be qualitative and relative. Force due to gravity is appropriate but only as a force that pulls objects down.

Assessment Boundaries: Quantitative force magnitude is not expected in state assessment. State assessment will be limited to one variable at a time: number, size, or direction of forces.

3-PS2-3. Conduct an investigation to determine the nature of the forces between two magnets based on their orientations and distance relative to each other.

Clarification Statement: Focus should be on forces produced by magnetic objects that are easily manipulated.

3-PS2-4. Define a simple design problem that can be solved by using interactions between magnets.*

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.

Not included from NGSS: 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Common Core Connections: ELA/Literacy – RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-PS2-1),(3-PS2-3) **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3) **RI.3.8** Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a

sequence). (3-PS2-3) **W.3.7** Conduct short research projects that build knowledge about a topic. (3-PS2-1) **W.3.8** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2- 1) **SL.3.3** Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-PS2-1) **MP.5** Use appropriate tools strategically. (3-PS2-1) **3.MD.A.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-PS2-1)

Grade 3: Technology/Engineering

ETS1. Engineering Design

3.3-5-ETS1-1. 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.*

3.3-5-ETS1-2. 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.*

Clarification Statement: Examples of design problems can include adapting a switch on a toy for children who have a motor coordination disability, designing a way to clear or collect debris or trash from a storm drain, or creating safe moveable playground equipment for a new recess game.

3.3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution.*

Clarification Statements: Examples of informational resources can include books, videos, and websites. Examples of representations can include graphic organizers, sketches, models, and prototypes.

*Found in grade 4: 3-5-ETS1-3. 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. 4.3-5-ETS1-5(MA). Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem.**

Common Core Connections: ELA/Literacy –W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1) **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. (3-5-ETS1-1) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1) **Mathematics – MP.2** Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2) **MP.4** Model with mathematics. (3-5-ETS1-1),(3-5-ETS1-2) **MP.5** Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2) **3-5.OA** Operations and Algebraic Thinking (3-5-ETS1-1),(3-5-ETS1-2)