# Plymouth Public Schools' Science and Technology/Engineering Program Grade 8 Integrated Science Learning Standards

STE018 Science 8

An Introduction to the Massachusetts Department of Elementary and Secondary Education Science and Technology/Engineering Curriculum Framework
Effective teaching and learning in science fosters engagement and has rigor, relevance, and coherence embedded within. It couples practice with content to give the context for performance. A program with these components encourages students to analyze and explain phenomena and experience; engages with practices to build, use, and apply knowledge; and builds a storyline over time and among disciplines. The state standards that form this program are outcomes that reflect what a student should know and be able to do as a result of instruction. Science and engineering practices, which are included in these standards, are not teaching strategies; they are important learning goals and skills to be learned, also as a result of instruction. The standards listed below are not intended to represent an exhaustive list of all that could be included in our district's science program, nor should this list prevent students from going beyond the standards where appropriate. (Excerpts from Curriculum Framework)

Overarching Theme – Cause and Effect
In grade 8, students use more robust abstract thinking skills to explain causes of complex phenomena and systems. Many causes are not immediately or physically visible to students. Students wrestle with the 'why' of science to deal with unseen mechanisms at work, to make predictions about future events, and to explain patterns. Their ability to conceptualize and describe what often cannot be seen is a significant outcome for students, as well as a thorough understanding of cause and effect. Topics include, but are not limited to causes of seasons and tides, causes of plate tectonics and weather or climate, the role of genetics in reproduction, heredity, and artificial selection, and how atoms and molecules interact to explain the substances that make up the world and how materials change. (Excerpts from Curriculum Framework)

ESS1. Earth's Place in the Universe

8.MS-ESS1-1b. Develop and use a model of the Earth-sun system to explain the cyclical pattern of seasons, which includes the Earth's tilt and differential intensity of sunlight on different areas of Earth across the year.

Clarification Statement:
Examples of models can be physical or graphical.

8.MS-ESS1-2. Explain the role of gravity in ocean tides, the orbital motions of planets, their moons, and asteroids in the solar system.

State Assessment Boundary:
Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth are not expected in state assessment.

ESS2. Earth's Systems

8.MS-ESS2-1. Use a model to illustrate that energy from the Earth's interior drives convection which 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.

Clarification Statement:
The emphasis is on large-scale cycling resulting from plate tectonics.

8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather.

Clarification Statements:
1. Data includes temperature, pressure, humidity, precipitation, and wind.
2. Examples of patterns can include air masses flow from regions of high pressure to low pressure, and how sudden changes in weather can result when different air masses collide.
3. Data can be provided to students (such as in weather maps, data tables, diagrams, or visualizations) or obtained through field observations or laboratory experiments.

State Assessment Boundary:
Specific names of cloud types or weather symbols used on weather maps are not expected in state assessment.

8.MS-ESS2-6. 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.

Clarification Statement:
A regional scale includes a state or multi-state perspective.

State Assessment Boundary:
Koppen Climate Classification names are not expected in state assessment.

ESS3. Earth and Human Activity

8.MS-ESS3-1. Analyze and interpret data to explain that the Earth's mineral and fossil fuel resources are unevenly distributed as a result of geologic processes.

Clarification Statement:
Examples of uneven distributions of resources can include where petroleum is generally found (locations of the burial of organic marine sediments and subsequent geologic traps), and where metal ores are generally found (locations of past volcanic and hydrothermal activity).

8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.

Clarification Statements:
1. Examples of human activities include fossil fuel combustion, deforestation, and agricultural activity.
2. Examples of evidence can include tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases such as carbon dioxide and methane; and the rates of human activities.

LS1. From Molecules to Organisms: Structures and Processes

8.MS-LS1-5. Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.

Clarification Statements:
1. Examples of environmental conditions could include availability of food, light, space, and water.
2. Examples of genetic factors could include the genes responsible for size differences in different breeds of dogs, such as great danes and chihuahuas.
3. Examples of environmental factors could include drought decreasing plant growth, fertilizer increasing plant growth, and fish growing larger in large ponds than they do in small ponds.
4. Examples of both genetic and environmental factors could include different varieties of plants growing at different rates in different conditions.

State Assessment Boundary:
Methods of reproduction, genetic mechanisms, gene regulation, biochemical processes, or natural selection are not expected in state assessment.

8.MS-LS1-7. 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.

State Assessment Boundary:
Specific details of the chemical reaction for cellular respiration, biochemical steps of breaking down food, or the resulting molecules (e.g., carbohydrates

LS3. Heredity: Inheritance and Variation of Traits

8.MS-LS3-1. 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.

Clarification Statements:
1. An example of a beneficial change to the organism may be a strain of bacteria becoming resistant to an antibiotic.
2. A harmful change could be the development of cancer; a neutral change may change the hair color of an organism with no direct consequence.

State Assessment Boundary:
Specific changes at the molecular level (e.g., amino acid sequence change), mechanisms for protein synthesis, or specific types of mutations are not expected in state assessment.

8.MS-LS3-2. 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.

Clarification Statements:
1. Examples of an advantage of sexual reproduction can include genetic variation when the environment changes or a disease is introduced, while examples of an advantage of asexual reproduction can include not using energy to find a mate and fast reproduction rates.
2. Examples of a disadvantage of sexual reproduction can include using resources to find a mate, while a disadvantage in asexual reproduction can be the lack of genetic variation when the environment changes or a disease is introduced.

8.MS-LS3-3(MA). 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.

State Assessment Boundary:
Specific changes at the molecular level or mechanisms for protein synthesis are not expected in state assessment.

8.MS-LS3-4(MA). Develop and use a model to show that sexually reproducing organisms have two of each chromosome in their nucleus, 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.

Clarification Statement:
Examples of models can include Punnett squares, diagrams (e.g., simple pedigrees), and simulations.

State Assessment Boundary:
State assessment will limit inheritance patterns to dominant-recessive alleles only.

LS4. Biological Evolution: Unity and Diversity

8.MS-LS4-4. 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.

Clarification Statements:
1. The model should include simple probability statements and proportional reasoning.
2. Examples of evidence can include Darwin's finches, necks of giraffes, and peppered moths.

State Assessment Boundary:
Specific conditions that lead to natural selection are not expected in state assessment.

8.MS-LS4-5. Synthesize and communicate information about artificial selection, or the ways in which humans have changed the inheritance of desired traits in organisms.

Clarification Statement:

Emphasis is on the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, and gene therapy).

PS1. Matter and Its Interactions

8.MS-PS1-1. 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.

Clarification Statement:
Examples of molecular-level models could include drawings, 3D ball and stick structures, and computer representations showing different molecules with different types of atoms.

State Assessment Boundary:
Valence electrons and bonding energy, the ionic nature of subunits of complex structures, complete depictions of all individual atoms in a complex molecule or extended structure, or calculations of proportions in mixtures are not expected in state assessment.

8.MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Clarification Statements:

1. Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl.
2. Properties of substances include density, melting point, boiling point, solubility, flammability, and odor.

8.MS-PS1-4. 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.

Clarification Statements:

1. Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs.
2. Examples of models could include drawings and diagrams.
3. Examples of pure substances could include water, carbon dioxide, and helium.

8.MS-PS1-5. Use a model to explain that substances are rearranged during a chemical reaction to form new molecules 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.

Clarification Statement:
Examples of models can include physical models or drawings, including digital forms, that represent atoms.

State Assessment Boundary:
Use of atomic masses, molecular weights, balancing symbolic equations, or intermolecular forces are not expected in state assessment.

PS2. Motion and Stability: Forces and Interactions

8.MS-PS2-1. Develop a model that demonstrates Newton's third law involving the motion of two colliding objects.

State Assessment Boundary:
State assessment will be limited to vertical or horizontal interactions in one dimension.

8.MS-PS2-2. 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.

Clarification Statement:
Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law) in one dimension.

State Assessment Boundaries:
1. State assessment will be limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time.
2. The use of trigonometry is not expected in state assessment.

ETS2. Materials, Tools, and Manufacturing

8.MS-ETS2-4(MA). 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.

Clarification Statements:

1. Examples of physical processing can include cutting, forming, extruding, and sanding.
2. Examples of changes in material properties can include a non-magnetic iron material becoming magnetic after hammering and a plastic material becoming rigid (less elastic) after heat treatment.

8.MS-ETS2-5(MA). 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.