

Plymouth Public Schools' Science and Technology/Engineering Program

Grade 7 Integrated Science Learning Standards

STE017 Science 7

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 – Systems and Cycles

In grade 7, students focus on systems and cycles to interpret information and apply concepts and skills in the broad context of the discipline. In doing so, they make connections between different domains of knowledge. The standards assigned to grade 7 highlight interdisciplinary connections within and across domains necessary to understand the complexity and interactivity of most natural and designed systems and cycles. Students begin a process of building expert knowledge, moving from a more concrete to an abstract perspective and creating a foundation for exploring cause and effect relationships. Students gain experience with plate tectonics, interactions of humans and Earth processes, ecosystem dynamics, motion and energy systems, and key technological systems used by society. (Excerpts from Curriculum Framework)

ESS2. Earth's Systems

7.MS-ESS2-2. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from local to global in size.

Clarification Statements:

1. Examples of processes occurring over large, global spatial scales include plate motion, formation of mountains and ocean basins, and ice ages.

2. Examples of changes occurring over small, local spatial scales include earthquakes and seasonal weathering and erosion.

7.MS-ESS2-4. 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.

Clarification Statement:

Examples of models can be conceptual or physical.

State Assessment Boundary:

A quantitative understanding of the latent heats of vaporization and fusion is not expected in state assessment.

ESS3. Earth and Human Activity

7.MS-ESS3-2. 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.

Clarification Statements:

1. Geologic events include earthquakes, volcanic eruptions, floods, and landslides.
2. Examples of data typically analyzed can include the locations, magnitudes, and frequencies of the natural hazards.

State Assessment Boundary:

Active analysis of data or forecasting is not expected in state assessment.

7.MS-ESS3-4. 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.

Clarification Statements:

1. Arguments should be based on examining historical data such as population graphs, natural resource distribution maps, and water quality studies over time.
2. Examples of negative impacts can include changes to the amount and quality of natural resources such as water, mineral, and energy supplies.

LS1. From Molecules to Organisms: Structures and Processes

7.MS-LS1-4. 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.

Clarification Statements:

1. Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalizations and colorful plumage to attract mates for breeding.
2. Examples of animal behaviors that affect the probability of plant reproduction could include
 - a. transferring pollen or seeds and
 - b. creating conditions for seed germination and growth.
3. Examples of plant structures that affect the probability of plant reproduction could include bright flowers attracting butterflies that transfer pollen, flower nectar, and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.

State Assessment Boundary:

Natural selection is not expected in state assessment.

LS2. Ecosystems: Interactions, Energy, and Dynamics

7.MS-LS2-1. 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.

7.MS-LS2-2. 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.

Clarification Statement:

Emphasis is on describing consistent patterns of interactions in different ecosystems in terms of relationships among and between organisms.

7.MS-LS2-3. 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.

Clarification Statements:

1. Cycling of matter should include the role of photosynthesis, cellular respiration, and decomposition, as well as transfer among producers, consumers (primary, secondary, and tertiary), and decomposers.
2. Models may include food webs and food chains.

State Assessment Boundary:

Cycling of specific atoms (such as carbon or oxygen), or the biochemical steps of photosynthesis, cellular respiration, and decomposition are not expected in state assessment.

- 7.MS-LS2-4. 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.

Clarification Statement:

Focus should be on ecosystem characteristics varying over time, including disruptions such as hurricanes, floods, wildfires, oil spills, and construction.

- 7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.

Clarification Statements:

1. Examples of design solutions could include water, land, and species protection, and the prevention of soil erosion.
2. Examples of design solution constraints could include scientific, economic, and social considerations.

- 7.MS-LS2-6(MA). 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.

Clarification Statement:

Examples of resources can include food, energy, medicine, and clean water.

PS2. Motion and Stability: Forces and Interactions

- 7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces.

Clarification Statement:

Includes both attractive and repulsive forces.

State Assessment Boundaries:

1. State assessment will be limited to proportional reasoning.
2. Calculations using Coulomb's law or interactions of sub-atomic particles are not expected in state assessment.

7.MS-PS2-5. 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.

Clarification Statement:

Emphasis is on evidence that demonstrates the existence of fields, limited to gravitational, electric, and magnetic fields.

State Assessment Boundary:

Calculations of force are not expected in state assessment.

PS3. Energy

7.MS-PS3-1. Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object.

Clarification Statements:

1. Examples could include riding a bicycle at different speeds and rolling different-sized rocks downhill.
2. Consider relationships between kinetic energy vs. mass and kinetic energy vs. speed separate from each other; emphasis is on the difference between the linear and exponential relationships.

State Assessment Boundary:

Calculations or manipulation of the formula for kinetic energy is not expected in state assessment.

7.MS-PS3-2. Develop a model to describe the relationship between the relative position of objects interacting at a distance and their relative potential energy in the system.

Clarification Statements:

1. Examples of objects within systems interacting at varying distances could include Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and, a balloon with static electrical charge being brought closer to a stream of water.
2. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.

State Assessment Boundaries:

1. State assessment will be limited to electric, magnetic, and gravitational interactions and to interactions of two objects at a time.
2. Calculations of potential energy are not expected in state assessment.

7.MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer.

Clarification Statement:

Examples of devices could include an insulated box, a solar cooker, and a vacuum flask.

State Assessment Boundary:

Accounting for specific heat or calculations of the total amount of thermal energy transferred is not expected in state assessment.

7.MS-PS3-4. 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.

State Assessment Boundary:

Calculations of specific heat or the total amount of thermal energy transferred are not expected in state assessment.

7.MS-PS3-5. Present evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Clarification Statement:

Examples of empirical evidence could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object.

State Assessment Boundary:

Calculations of energy are not expected in state assessment.

7.MS-PS3-6(MA). 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-PS3-7(MA). Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another.

Clarification Statement:

Types of kinetic energy include motion, sound, thermal, and light; types of potential energy include gravitational, elastic, and chemical.

ETS1. Engineering Design

7.MS-ETS1-2. 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.

7.MS-ETS1-4. 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.

7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.

ETS3. Technological Systems

7.MS-ETS3-1(MA). Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage.

7.MS-ETS3-2(MA). Compare the benefits and drawbacks of different communication systems.

Clarification Statements:

1. Examples of communications systems can include radio, television, print, and Internet.
2. Examples of benefits and drawbacks can include speed of communication, distance or range, number of people reached, audio only vs. audio and visual, and one-way vs. two-way communication.

7.MS-ETS3-3(MA). 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.

Clarification Statements:

1. Examples of design elements include vehicle shape to maximize cargo or passenger capacity, terminals, travel lanes, and communications/controls.
2. Examples of vehicles can include a car, sailboat, and small airplane.

7.MS-ETS3-4(MA). 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.

Clarification Statements:

1. Examples of components of a structural system could include foundation, decking, wall, and roofing.
2. Explanations of function should include identification of live vs. dead loads and forces of tension, torsion, compression, and shear.
3. Examples of uses include carrying loads and forces across a span (such as a bridge), providing livable space (such as a house or office building), or providing specific environmental conditions (such as a greenhouse or cold storage).

State Assessment Boundary:

Calculations of magnitude or direction of loads or forces are not expected in state assessment.

7.MA-ETS3-5(MA). Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system.