

Massachusetts Science and Technology/Engineering Curriculum Framework

The design of this unit and its activities address the goal of inquiry based instruction within the Massachusetts Frameworks

Engaging students in inquiry-based instruction is one way of developing conceptual understanding, content knowledge, and scientific skills. Scientific inquiry as a means to understand the natural and human-made worlds requires the application of content knowledge through the use of scientific skills. Students should have curricular opportunities to learn about and understand science and technology/engineering through participatory activities, particularly laboratory, fieldwork, and design challenges.

As a result of completing this unit, students will address the following Grade 6-8 *Earth and Space Science* learning standards:

4. *Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land, and atmosphere.*
10. *Compare and contrast properties and conditions of objects in the solar system (i.e., sun, planets, and moons) to those on Earth (i.e., gravitational force, distance from the sun, speed, movement, temperature, and atmospheric conditions)*

As a result of completing this unit, students will address the following High School *Earth and Space Science* content standards:

1. Matter and Energy in the Earth System

Central Concepts: The entire Earth system and its various cycles are driven by energy. Earth has both internal and external sources of energy. Two fundamental energy concepts included in the Earth system are gravity and electromagnetism.

- 1.1 *Identify Earth's principal sources of internal and external energy, such as radioactive decay, gravity, and solar energy.*
- 1.2 *Describe the characteristics of electromagnetic radiation and give examples of its impact on life and Earth's systems.*
- 1.8 *Read, interpret, and analyze a combination of ground-based observations, satellite data, and computer models to demonstrate Earth systems and their interconnections.*

4. The Origin and Evolution of the Universe

Central Concepts: The origin of the universe, between 14 and 15 billion years ago, still remains one of the greatest questions in science. Gravity influences the formation and life cycles of galaxies, including our own Milky Way Galaxy; stars; planetary systems; and residual material left from the creation of the solar system.

- 4.2 *Describe the influence of gravity and inertia on the rotation and revolution of orbiting bodies. Explain the Sun-Earth-moon relationships (e.g., day, year, solar/lunar eclipses, tides).*

As a result of completing this unit, students will address the following High School *Earth and Space Science* inquiry standards:

SIS1. Make observations, raise questions, and formulate hypotheses.

- *Observe the world from a scientific perspective.*
- *Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge.*
- *Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.*

SIS2. Design and conduct scientific investigations.

- *Articulate and explain the major concepts being investigated and the purpose of an investigation.*
- *Employ appropriate methods for accurately and consistently*
 - *making observations*
 - *making and recording measurements at appropriate levels of precision*
 - *collecting data or evidence in an organized way*
- *Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.*

SIS3. Analyze and interpret results of scientific investigations.

- *Present relationships between and among variables in appropriate forms.*
- *Represent data and relationships between and among variables in charts and graphs.*
- *Use appropriate technology (e.g., graphing software) and other tools.*
- *Use mathematical operations to analyze and interpret data results.*
- *Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions.*

SIS4. Communicate and apply the results of scientific investigations.

- *Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations.*
- *Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation.*
- *Explain diagrams and charts that represent relationships of variables.*
- *Construct a reasoned argument and respond appropriately to critical comments and questions.*
- *Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings.*

As a result of completing this unit, students will address the following High School *Earth and Space Science* mathematical skills:

- ✓ Construct and use tables and graphs to interpret data sets.
- ✓ Solve simple algebraic expressions.
- ✓ Perform basic statistical procedures to analyze the center and spread of data.
- ✓ Measure with accuracy and precision (e.g., length, volume, mass, temperature, time)
- ✓ Convert within a unit (e.g., centimeters to meters).
- ✓ Use common prefixes such as milli-, centi-, and kilo-.
- ✓ Use scientific notation, where appropriate.
- ✓ Use appropriate metric/standard international (SI) units of measurement for mass (kg); length (m); time (s); force (N); speed (m/s); acceleration (m/s^2); and frequency (Hz).
- ✓ Use the Celsius and Kelvin scales.

As a result of completing this unit, students will address the following High School *Introductory Physics* content standards:

1. Motion and Forces

Central Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

- 1.2 Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration.
- 1.4 Interpret and apply Newton's three laws of motion.
- 1.5 Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
- 1.7 Describe Newton's law of universal gravitation in terms of the attraction between two objects, their masses, and the distance between them.
- 1.8 Describe conceptually the forces involved in circular motion.

3. Heat and Heat Transfer

Central Concept: Heat is energy that is transferred by the processes of convection, conduction, and radiation between objects or regions that are at different temperatures.

- 3.1 Explain how heat energy is transferred by convection, conduction, and radiation.

4. Waves

Central Concept: Waves carry energy from place to place without the transfer of matter.

- 4.1 Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.

6. Electromagnetic Radiation

Central Concept: Oscillating electric or magnetic fields can generate electromagnetic waves over a wide spectrum.

- 6.1 *Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.*
- 6.2 *Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green, blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the spectrum.*