Milford Public Schools Curriculum

Department: SCIENCE
Course Name: Sixth Grade Earth and Space Science
Course Description:

In sixth grade students will develop an understanding of how Earth consists of a set of systems -atmosphere, hydrosphere, geosphere and biosphere- that are intricately interconnected. These systems have differing sources of energy, and matter cycles within and among them in multiple ways and on various time scales. Small changes in one can have large consequences in another or no effect at all. Examining these systems allows students to comprehend how the Earth "works" and continuously changes. Students will also examine how the Earth is part of a broader solar system which is also one of many galaxies in the Universe.

The performance expectations in sixth grade help students formulate answers to questions such as: "What is Earth's place in the Universe, What makes our solar system and how can the motion of the Earth explain seasons and eclipses, and How do people figure out that the Earth and life on Earth have changed through time?" Students will examine and analyze geoscience evidence and data used to illustrate Earth's history and its ever changing landforms. They will apply their understanding as they build models to represent natural phenomena which occur in each of Earth's systems and in space. There is a strong connection to engineering through the instruments and technologies that have allowed us to explore objects in space and obtain data that explains the evolution of the Universe. Students will also examine how living things interact with our planet and design solutions to some of the problems associated with increasing world populations and changing habitats.

The crosscutting concepts of patterns; cause and effect; stability and change, energy and matter, scale and proportion, systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society,are called out as organizing concepts for these disciplinary core ideas.

UNIT 1 - The Universe, Stars, and The Solar System	
The Big Bang Theory and the history of the Universe is explained including the forces which keep the structures in motion. The formation/life cycle of stars and galaxies is investigated including the Milky Way. Our solar system is explored emphasizing the relationships between the Sun, Moon and Earth and how it impacts phenomena on our planet such as tides and seasons.	
LEARNING GOALS	
Enduring Understanding(s): Everything in the universe was created by the Big Bang. The sun is one of a vast number of stars in the universe. The objects in the solar system are in constant motion and that motion follows regular patterns. Gravity is the force responsible for the solar system Position, attraction and motion of planets affects the	**Essential Question(s):** How can patterns be used to describe the Universe? How do the different parts of the Solar System interact to form a system? How can we know if objects in the solar system will collide?

natural cycles of Earth.	

Content and Skills:

- Formation of the universe and our solar system
- Relationships between objects in the solar system
- Size and scale in the solar system
- Motion in the solar system and resulting phenomena on Earth (seasons, phases of the moon, eclipses, and tides)
- Interpret data in order to explain natural phenomena

Performance Expectations:
Students will be able to:
Develop and use models to describe the role of gravity in the motions within galaxies and within the solar system.
Analyze data to describe similarities and differences among solar system objects by describing patterns of features of those objects at different scales.
Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, seasons, and tides.

Standards Addressed:

NGSS Disciplinary Core Ideas
ESS1.A The Universe & The Stars
- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.

ESS1.B Earth & The Solar System
- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.

ESS1-3 Analyze and Interpret Data to Determine Scale Properties Of Objects in the Solar Systems
- Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include distance from the sun and diameter.

NGSS Scientific and Engineering Practices
Asking Questions, Developing and Using Models, Analyzing and Interpreting Data, Using Mathematics, Obtaining, Evaluating, and Communicating Information

NGSS Crosscutting Concepts
Patterns, Systems and System Models, Scientific Nature Assumes an Order and Consistency in Natural Systems

UNIT 2 - History of Planet Earth

Examination of the geological time scale which organizes Earth's history, including the the formation of mountain chains, ocean basins, volcanic activity, glaciation, and the development of watersheds and rivers. Analysis of both rock strata and fossils helps students understand past life forms as well as locations which may have changed over time.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
The Earth has changed (and continues to change) over time.	How do people figure out that the Earth has changed through time?
Living things are both changed by the Earth and have changed the Earth over time.	How have living organisms changed the Earth over time and how have Earth's changing conditions impacted organisms?

Content and Skills:

- Formation and continuous evolution of the Earth
- Earth's life history according to rock strata and fossils
- Analysis of geological features/evidence
- Effect of moving glaciers

Performance Expectations:
Students will be able to:
Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Emphasis on the process of melting, crystallization, weathering, deformation, and sedimentation which act together to form minerals and rocks through the cycling of Earth's materials.

Standards Addressed:
NGSS Disciplinary Core Ideas
ESS1.C History of Planet Earth
- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.

ESS2.A (geosphere only) rock cycle
- All Earth's processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

ESS2.E Biogeology
- Living things affect the physical characteristics of their regions.

NGSS Scientific and Engineering Practices
Constructing Explanations and Designing Solutions

NGSS Crosscutting Concepts
Scale, Proportion, and Quantity

UNIT 3 - Plate Tectonics and Landforms

Examination of the theory of Plate Tectonics which helps to explain past and current movement of rocks at Earth's surface and provides a coherent account of Earth's history. Multiple sources of evidence are explored such as patterns of earthquake locations, ocean floor spreading over time, and changing magnetic patterns. These movements are driven by heating and cooling of Earth materials and gravity. Plate movement both creates and destroys ocean basins, mountains, plateaus and volcanoes.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
The Earth is constantly changing due to internal and external forces. Scientists use physical and biological evidence to explain how Earth's surface over time.	How do we know materials in and on Earth's crust change over time? What will Earth look like in the future?

Content and Skills:

- Layers of the Earth
- Causes and effects of plate tectonics

Performance Expectations:
Students will be able to:
Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Standards Addressed:
NGSS Disciplinary Core Ideas
ESS2.B Plate Tectonics & Large Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

ESS3.B Natural Hazards (tsunamis, earthquakes, and volcanoes only)

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

NGSS Scientific and Engineering Practices
Developing and Using Models, Analyzing and Interpreting Data, Scientific Knowledge is Open to Revision in Light of New Evidence

NGSS Crosscutting Concepts
Stability and Change, Patterns

UNIT 4 - Roles of Water on Earth

Water on Earth is abundant and possesses unique physical and chemical properties which allow it to move across the surface of the planet in all three states of matter, as energy from the sun and gravity act on it. Both saltwater and freshwater can act as forces of erosion and may be responsible for transporting and depositing materials which can create, alter and destroy landforms.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
The sun's energy and gravity continuously move water between states of matter and through land, bodies of water and the atmosphere. Water's movements cause changes in the Earth's surface over time. All Earth's systems are affected by water.	How is water a "force of nature"?

Content and Skills:

- Water cycle
- Variations in ocean temperature, salinity, and currents.
- Water's movements - both onland and underground - cause weathering and erosion, which change the land's surface features and create underground formations.

Performance Expectations:
Students will be able to:
Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Standards Addressed:
NGSS Disciplinary Core Ideas
ESS2.C Roles of Water in Earth's Surface Processes

- Water's movements - both on the land and underground - cause weathering and erosion, which change the land's surface features and create underground formations.

ESS3.B Natural Hazards (sink holes only)

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

ESS2.A (hydrosphere only)

- All Earth's processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

NGSS Scientific and Engineering Practices

Developing and Using Models

NGSS Crosscutting Concepts
Energy and Matter

UNIT 5 - Weather and Climate

Weather and climate are shaped by complex interactions involving sunlight, the ocean, the atmosphere, ice, landforms and living things. Ocean and wind currents can moderate world climates. Gases in the atmosphere create a habitable planet and impact the way energy will be transferred between these layers creating weather events.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
1. 2. Energy from the sun is trapped by the Earth's atmosphere, drives weather, and supports life on Earth. Changes in energy on the surface of the Earth create specific climates.	What's more important in determining weather and climate on Earth-the Sun or gravity? Is it possible to accurately predict the weather?

Content and Skills:

- Effect of energy on temperature and density and their resulting influence on wind, air masses, and ocean currents
- How interactions between various factors influence weather and climate

Performance Expectations:
Students will be able to:
Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Standards Addressed:
NGSS Disciplinary Core Ideas
ESS2.D Weather & Climate
- Because these patterns are so complex, weather can only be predicted probabilistically.

ESS3.B Natural Hazards (droughts, wildfires, floods, and coastal erosion)
- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

ESS2.A (atmosphere)
- All Earth's processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

NGSS Scientific and Engineering Practices
Planning and Carrying Out Investigations, Developing and Using Models

NGSS Crosscutting Concepts
Cause and Effect, Systems and System Models

UNIT 6 - Natural Resources and Human Impact

The relationship that humans have with natural resources is examined; how we harness their energy, both use and conserve them, and attempt to replace them. Since humans have become one of the most significant agents of change, in this course we will attempt to emphasize the responsible management of natural resources and technologies to reverse impact. Prior geological concepts are reconnected as global distribution of natural resources is explored as well as methods to extract them. Climate change is examined as this mixture of gases has changed throughout history.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
Populations are affected by environmental conditions that fluctuate over time. Human activity can affect the stability of ecosystems. Water is a vital, valuable, limited resource that should be monitored and conserved.	How does where you live affect how you live? How are humans responsible for their environment?

Content and Skills:

- Locations of natural resources and the geological processes that formed them
- Many of these resources are finite
- Effects of humans on availability of resources
- Analysis of evidence of recent climate change
- How humans are working to protect natural resources and, in some cases, develop alternatives

Performance Expectations:
Students will be able to:
Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Standards Addressed:
NGSS Disciplinary Core Ideas
ESS3.A Natural Resources

- Humans depend on Earth's land, oceans, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

ESS3.C Human Impact on Earth's Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

ESS3.D Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

NGSS Scientific and Engineering Practices

Engaging in Argument from Evidence, Asking Questions and Defining Problems/Developing and Using Models

NGSS Crosscutting Concepts

Cause and Effect, Influence of Science, Engineering, and Technology on Society and the Natural World, Science Addresses Questions About the Natural and Material World, Stability and Change