Nashoba Regional School District

SCIENCE AND TECHNOLOGY/ ENGINEERING

Standards and Benchmarks
Grade 4

Nashoba Regional School District Science and Technology/Engineering Standards and Benchmarks, 2006.

Work in this document is based upon the standards outlined in the Massachusetts Science and Technology/Engineering Curriculum Framework (2001), updated (2006).

SCIENCE AND TECHNOLOGY/ENGINEERING

Acknowledgements

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Overview

The Massachusetts Science and Technology/Engineering Curriculum Framework was used as the guide for developing the NRSD Standards and Benchmarks document. "Mastery" expectations have been identified for each grade level in accordance with these documents. Mastery expectations should be based on grade-appropriate developmental performance levels.

Each grade includes curriculum for the four strands: Earth and Space Science, Life Science, Physical Science, and Technology and Engineering. Each strand includes the appropriate Learning Standards, Big Ideas, and Essential Questions. Additionally, further ideas and resources are included to help guide the teaching of the given unit topic/theme. These resources include: Learning Experiences and Investigations, suggested Coverage Timeline, Assessments, and Resources. It is our expectation that this "resource" section will continue to improve and develop over time.

Science and Technology/Engineering by Grade Level
Grade: 4
Standards and Benchmarks

Massachusetts Science and Technology/Engineering Curriculum Framework (2001), updated (2006)

EARTH AND SPACE SCIENCE STRAND

UNIT/TOPIC THEME: Weather and the Water Cycle

Grade 4 students will demonstrate **MASTERY** of the following learning standards[1]:

Learning Standard ES 6
Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.

Learning Standard ES 7
Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.

Learning Standard ES 8
Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.

Learning Standard ES 9
Differentiate between weather and climate.

Learning Standard ES 10
Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.

Learning Standard ES 11
Give examples of how the cycling of water, both in and out of the atmosphere, has an effect on climate.

Big Ideas

There is a difference between climate and weather.
Global effects can influence local weather.
Climate can change over time.
Weather is a condition of the atmosphere at a given time and place and is made up of moisture, temperature, and wind.
Water cycles have an effect on climate.

Essential Questions

How do we gather and use weather data to make decisions in our lives?
How do global patterns affect weather and climate?
How is a particular habitat created by weather and climate?

[1] Expectations should be based on an appropriate developmental performance level.

EARTH AND SPACE SCIENCE STRAND – continued…

Coverage Timeline

- It is recommended that you plan for 4 weeks of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

Possible Investigations and Learning Experiences

- To illustrate convection (essential in transferring both heat and moisture around the world; drives both wind circulation and ocean currents) freeze a dark solution of food coloring and water in an ice cube tray. Float a colored ice cube on water in a transparent container. Discuss what happens, and how it is connected to convection in both liquid and gas.
- Use a collection of classical (not digital) weather instruments that clearly show the physical principle that makes them work. Collection includes thermometer, barometer, rain gauge, hygrometer, and anemometer.
- Measure various forms of precipitation. Bring a measured sample of snow into the classroom, allow it to melt, and compare to the original measurement .
- Collect daily temperature and precipitation data, preferably by observation, at your school. At the same time use the internet or a newspaper to collect the same data for a nearby city and a city on the west coast of the U.S. After three months, take various averages of the daily data for the three locations. Graph the data. Discuss how the long-term daily weather averages begin to describe each climate.

Suggested Extensions to Learning in Technology/Engineering

- Using measuring tools or graph paper, sketch a scale drawing of the front view of an object used to measure weather. (T/E 1.2, 2.2, 2.3)
- Design and construct a variety of simple instruments that could be used to measure weather. Discuss how the design suits the purpose.
  (T/E 1.1, 1.2, 2.3)
- Explain how tools of technology such as a hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners can be used to make or build weather instruments. (T/E 1.1, 1.2)
- Construct various weather station instruments (e.g., wind gauge, barometer, anemometer), record data from them, and make conclusions. (T/E 1.1, 1.2, 2.1, 2.2, 2.3)
- To make a model of the jet stream, fill a jar halfway with warm water. Sprinkle some pepper into the water to represent nutrients on the ocean floor. Put a colored ice cube into the jar. Students should draw and describe their observations. (T/E 2.2)
- Discuss tools used to measure everyday weather compared with tools used in determining climate. (T/E 1.2)
- Use a thermometer and barometer to compare conditions indoors and outdoors. (T/E 2.4).

Resources

- Bill Nye DVDs
- Weather Instruments

LIFE SCIENCE STRAND

UNIT/TOPIC THEME: Adaptations of Living Things

Grade 4 students will demonstrate **MASTERY** of the following learning standards:

Learning Standard LS 7

Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).

Learning Standard LS 8

Describe how organisms meet some of their needs in an environment by using behaviors (patterns of activities) in response to information (stimuli) received from the environment. Recognize that some animal behaviors are instinctive (e.g., turtles burying their eggs), and others are learned (e.g., humans building fires for warmth, chimpanzees learning how to use tools).

Learning Standard LS 9

Recognize plant behaviors, such as the way seedlings stems grow toward light and their roots grow downward in response to gravity. Recognize that many plants and animals can survive harsh environments because of seasonal behaviors, e.g., in winter, some trees shed leaves, some animals hibernate, and other animals migrate.

Learning Standard LS 10

Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.

Big Ideas

Organisms use different behaviors to survive in their environments.
The environment can cause changes in plant and animal behavior.
Plants and animals can cause changes in their environment.

Essential Questions

What are the basic needs of all organisms?
How do organisms change their behavior in order to survive in their environments?
How does the environment affect the survival of the living things within it?

Coverage Timeline

- It is recommended that you coordinate this unit with the subsequent unit "Energy and Living Things". You may plan for 4 weeks of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

Investigations and Learning Experiences

- Investigate how invasive species out-compete native plants (e.g., phragmites and purple loosestrife). Discuss how some native plants die as a result.
- Discuss how newly born sea turtles find their way to the ocean.
- Discuss how pets are trained to learn new tricks.
- Discuss why and how migrating birds navigate.
- Discuss the actions that coastal species take to adjust to the changing level of the tide.

LIFE SCIENCE STRAND – continued…

Investigations and Learning Experiences

- Observe an earthworm placed on top of soil in a container that is exposed to light. Discuss how its ability to sense light helps it survive (by burrowing) and how its structure allows it to burrow through soil.
- Set a germinating bean in a glass filled with water next to an asymmetric source of light. Allow the root and stem to grow a few inches. Rotate the bean so that the roots are now touching the water at an angle and the stem is away from the light source. Observe how the root system and stem respond to this change by changing their direction of growth.
- Discuss the importance of wetlands to human survival.
- Describe how the human action of draining wetlands can impact other organisms and the environment.
- Investigate how an invasive species changes an ecosystem.
- Research local projects where humans are changing the environment to ensure a species' survival.

Suggested Extension to Learning in Technology/Engineering

- Brainstorm and sketch things in the home that are designed to help humans survive **(**e.g., heater for warmth, stove to cook**)**. (T/E 2.1, 2.2)

Resource

- FOSS kit, "Structures of Life"

LIFE SCIENCE STRAND – continued…

UNIT/TOPIC THEME: Energy and Living Things

Grade 4 students will demonstrate **MASTERY** of the following learning standard:

Learning Standard LS 11

Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.

Big Ideas

Plants obtain their energy from the sun.
Plants make their own food through photosynthesis.
Plants are an important of the food chain.

Essential Questions

What is the inter-relationship between the sun, plants and animals?
How does the food chain complete this change?

Coverage Timeline

- See recommendation outlined in "Adaptations of Living Things".

Investigations and Learning Experiences

- Make a food chain. Begin with the sun as the source of energy and end with decomposers.
- Create links that show the relationship of plants and animals in the chain. Show the direction of the flow of energy. Discuss results if various links in the chain are broken.

Suggested Extensions to Learning in Technology/Engineering

- Design and build a compost bin. Use a thermometer to measure the temperature rise during composting. Discuss where heat (energy) comes from (decomposers metabolize energy stored by producers and consumers). (T/E 1.2)

PHYSICAL SCIENCE STRAND

Grade 4 students will demonstrate **MASTERY** of the following learning standards:

UNIT/TOPIC THEME*:* Light and Sound Energy

Learning Standard PS 4

Identify the basic forms of energy: light and sound[2].
Recognize that energy is the ability to cause motion or create change.

Learning Standard PS 11

Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.

Learning Standard PS 12

Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

Big Ideas

The basic forms of energy cause motion or create change.
Light and sound are forms of energy that cause motion and create change.

Essential Questions

How does energy create change?
How are different sounds produced?
How does light behave as it strikes different objects?
How do we use light and sound energy in our lives?
What are the basic needs of all organisms?

Coverage Timeline

- It is recommended that you plan for 4 weeks of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

Investigations and Learning Experiences

- Play music through a speaker with and without a grill cover. Discuss the difference in sound.
- Use tuning forks to demonstrate the relationship between vibration and sound
- Use a flashlight, mirrors, and water to demonstrate reflection and refraction.
- Identify whether a material is transparent, translucent, or opaque.

[2] Please note that Standard PS 4 has been "unpacked". Light and Sound are to be addressed at Grade 4; Heat, electric, and magnetic energy are to be addressed at Grade 5.

PHYSICAL SCIENCE – continued…

Suggested Extensions to Learning in Technology/Engineering

- Design and construct a telephone (prototype) using a variety of materials (e.g., paper cups, string, tin cans, and wire). Determine which prototype works best. Discuss possible reasons. (T/E 1.1, 1.2, 2.2, 2.3)
- Design and build a prototype to inhibit solar heating of a car (e.g., windshield reflector, window tinting). (T/E 1.1,1.2, 2.1, 2.3)
- Design and build a pinhole camera. Test the effects of light on light sensitive paper. (T/E 1.2, 2.3) or use photosensitive paper and test how it works in different light settings and with different angles of incoming light.
- Design and build a periscope from cardboard and mirrors. (T/E 1.1, 1.2, 2.3)
- Design an ideal structure for the human eye in terms of angle of light and type of surface the light should strike within the eye. (T/E 2.4)
- Design an ideal structure for hearing sounds through the ear. (T/E 2.4)

Resources

- Physics of Sound FOSS Kit
- Science Court
- Scott Foresman
- Science Companion Kit - Light

TECHNOLOGY AND ENGINEERING STRAND

UNIT/TOPIC THEME: Materials and Tools/Engineering Design

The following standards will be **REINFORCED** for Grade 4 students:

Learning Standard T/E 1.1
Identify materials used to accomplish a design task based on a specific property, i.e., weight, strength, hardness, and flexibility.

Learning Standard T/E 1.2
Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.

Learning Standard T/E 2.1
Identify a problem that reflects the need for shelter, storage, or convenience.

Learning Standard T/E 2.2
Describe different ways in which a problem can be represented (e.g., sketches, diagrams, graphic organizers, and lists).

Learning Standard T/E 2.3
Identify relevant design features (e.g., size, shape, weight for building a prototype of a solution to a given problem).

Learning Standard T/E 2.4
Compare natural systems with mechanical systems that are designed to serve similar purposes.

Coverage Timeline:

- It is recommended that technology and engineering standards should permeate all other units in such a way that students are able to make connections to real-life applications of the material learned throughout the school year.

Possible Investigations and Learning Experiences

From Earth and Space Science Strand:

- Using measuring tools or graph paper, sketch a scale drawing of the front view of an object used to measure weather. (T/E 1.2, 2.2, 2.3)
  Design and construct a variety of simple instruments that could be used to measure weather. Discuss how their design suits their purpose. (T/E 1.1, 1.2, 2.3)
- Explain how tools of technology such as a hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners can be used to make or build weather instruments. (T/E 1.1, 1.2)
- Construct various weather station instruments (e.g., wind gauge, barometer, anemometer), record data from them, and make conclusions.
  (T/E 1.1, 1.2, 2.1, 2.2, 2.3)

TECHNOLOGY AND ENGINEERING STRAND - continued…

Possible Investigations and Learning Experiences

From Earth and Space Science Strand:

- To make a model of the jet stream, fill a jar halfway with warm water. Sprinkle some pepper into the water to represent nutrients on the ocean floor. Put a colored ice cube into the jar. Students should draw and describe their observations. (T/E 2.2)
- Discuss tools used to measure everyday weather compared with tools used in determining climate. (T/E 1.2)
- Use a thermometer and barometer to compare conditions indoors and outdoors. (T/E 2.4).

From Life Science Strand:

- Brainstorm and sketch things in the home that are designed to help humans survive (e.g., heater for warmth, stove to cook). (T/E 2.1, 2.2)
- Design and build a compost bin. Use a thermometer to measure the temperature rise during composting. Discuss where heat (energy) comes from (decomposers metabolize energy stored by producers and consumers). (T/E 1.2)

From Physical Science Strand

- Design and construct a candle wheel that demonstrates how heat can cause a propeller to spin (a very popular craft toy). (T/E 1.1, 1.2, 2.2, 2.3)
- Design and construct a telephone (prototype) using a variety of material, (e.g., paper cups, string, tin cans, and wire). Determine which prototype works best. Discuss possible reasons. (T/E 1.1, 1.2, 2.2, 2.3)
- Design and build a prototype to inhibit solar heating of a car (e.g., windshield reflector, window tinting). (T/E 1.1,1.2, 2.1, 2.3)
- Design and build a pinhole camera. Test the effects of light on light sensitive paper. (T/E 1.2, 2.3) or use photosensitive paper and test how it works in different light settings and with different angles of incoming light.
- Design and build a periscope from cardboard and mirrors. (T/E 1.1, 1.2, 2.3)
- Design an ideal structure for the human eye in terms of angle of light and type of surface the light should strike within the eye. (T/E 2.4)
- Design an ideal structure for hearing sounds through the ear.(T/E 2.4)

TECHNOLOGY AND ENGINEERING STRAND - continued…

Possible Investigations and Learning Experiences

	Adaptations of Living Things Energy and Living Things	Sound & Light Energy	Weather
T/E 1.1 Identify materials used to accomplish a design task based on a specific property (e.g., weight, strength, hardness, flexibility).			Explain how tools of technology such as a hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners can be used to make or build weather instruments. (T/E 1.1)
T/E 1.2 Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails and other mechanical fasteners to construct a given prototype safely).	Design and build a compost bin. Use a thermometer to measure the temperature rise during composting. Discuss where heat (energy) comes from (decomposers metabolize energy stored by producers and consumers). (T/E 1.2)		Discuss tools used to measure everyday weather compared with tools used in determining climate. (T/E 1.2)

TECHNOLOGY AND ENGINEERING STRAND - continued…

Possible Investigations and Learning Experiences

	Adaptations of Living Things Energy and Living Things	Sound & Light Energy	Weather
T/E 2.1 Identify a problem that reflects the need for shelter, storage, or convenience.		Design and build a prototype to inhibit solar heating of a car, (e.g., windshield reflector, window tinting). (T/E 1.2, 2.1, 2.3)	
T/E 2.2 Describe different ways in which a problem can be represented, (e.g., sketches, diagrams, graphic organizers, and lists).		Design and build a simple roller coaster for a marble or toy car to demonstrate how energy changes from one form to another. (T/E 2.2, 2.3)	Design and construct a variety of simple instruments that could be used to measure weather. Discuss how their design suits their purpose. (T/E 2.1-2.4) To make a model of the jet stream, fill a jar halfway with warm water. Sprinkle some pepper into the water to represent nutrients on the ocean floor. Put a colored ice cube into the jar. Students should draw and describe their observations. (T/E 2.2)

TECHNOLOGY AND ENGINEERING STRAND - continued…

Possible Investigations and Learning Experiences

	Adaptations of Living Things Energy and Living Things	Sound & Light Energy	Weather
T/E 2.3: Identify relevant design features (e.g., size, shape, weight for building a prototype of a solution to a given problem).		Design and build a prototype to inhibit solar heating of a car, (e.g., windshield reflector, window tinting). (T/E 1.2, 2.1, 2.3) Design and build a pinhole camera. Test the effects of light on light sensitive paper. (T/E 1.2, 2.3) Design and build a periscope from cardboard and mirrors. (T/E 1.1, 1.2, 2.3) Design and construct a candle wheel that demonstrates how heat can cause a propeller to spin (a very popular craft toy). (T/E 1.1, 1.2, 2.2, 2.3)	Design and construct a variety of simple instruments that could be used to measure weather. Discuss how their design suits their purpose. (T/E 2.1-2.4)

TECHNOLOGY AND ENGINEERING STRAND - continued…

Possible Investigations and Learning Experiences

	Adaptations of Living Things Energy and Living Things	Sound & Light Energy	Weather
T/E 2.4: Compare natural systems with mechanical systems that are designed to serve similar purposes.			Design and construct a variety of simple instruments that could be used to measure weather. Discuss how their design suits their purpose. (T/E 2.1-2.4) Use a thermometer and barometer to compare conditions indoors and outdoors. (T/E 2.4)