Nashoba Regional School District

SCIENCE AND TECHNOLOGY/ ENGINEERING

Standards and Benchmarks
Grade 5

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

The Science and Technology/Engineering Standards and Benchmarks documents are the result of the work of a cross-section of elementary teachers from within the Nashoba Regional School District. These dedicated teachers spent over a year researching, writing, and editing curriculum that mapped to state mandated standards. The district recognizes the ongoing support of building and district administrators, the excellent work of the Science Task Force, district grade-level teachers, and especially the following people:

Bonnie Cook
Susan Dalton
Cynthia Finan
Jennifer Harris
Greg Irvine
Carol Johnson
Erin Keaney
Jenn Lavigne
Cyndie Maxfield
Matthew McDowell
Tania Rich
Diane Tenen
Suzanne Wintle
Lauren Ziobro

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: 5
Standards and Benchmarks

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

EARTH AND SPACE SCIENCE STRAND

UNIT/TOPIC THEME: Soil & Landforms and Earth's History

Grade 5 students will demonstrate **MASTERY** of the following learning standards:[1]

Learning Standard ES 4

Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains).

Learning Standard ES 5

Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants.

Learning Standard ES 12

Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.

Big Ideas

The Earth's surface is varied and changing.
Both natural and man-made processes affect the Earth's surface.

Essential Questions

Why is the Earth's surface so varied?
How is soil formed?
What is the composition of soil?

Coverage Timeline

- It is recommended that you plan for 8-10 sessions of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

Possible Investigations and Learning Experiences

- Perform a soil "shake test" in a vial to observe sedimentation and layering by weight of primary soil components (sand, silt, clay, and organic/inorganic matter).
- Study erosion effects both locally and globally.
- Observe sand with a hand lens. Note how particles resemble minerals. Observe topsoil with a hand lens. Look for fragments of organisms. Note differences in color, texture, odor, and clumping due to organic components vs. pure sand. Mix topsoil and sand together in various proportions to represent samples of types of soils.

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

EARTH AND SPACE SCIENCE STRAND – continued…

Possible Investigations and Learning Experiences

- Design an experiment to find out if different soil samples retain different amounts of water. Explain how the properties of the particles affect the large-scale properties of the soil, like water retention and speed of water flow. Discuss how a soil's water retention affects the animals and plants that live in it.

Suggested Extensions to Learning in Technology/Engineering

- Design a flow chart to demonstrate how silica from sand is used to make glass. (T/E 1.2)
- Design and construct a composting bin being sure to keep design considerations in mind (e.g., aeration, resistance to rot, etc.). (T/E 1.2, 2.1-2.3)
- Use sieves of different mesh sizes to separate coarse and fine materials in a soil sample. Approximate the ratio of fine to coarse material in the sample. Discuss how these different sizes of particles affect the soil. (T/E 1.2)
- Construct a model landform environment to demonstrate the variety of features present in a given land mass. (T/E 1.1,1.2,2.3)

Assessments

- FOSS
- Student projects and investigation wrap-ups
- Unit tests

Resources:

- FOSS Kit, "Land Forms"
- Science Court series
- Bill Nye videos
- FOSS stream table

EARTH AND SPACE SCIENCE STRAND - continued…

UNIT/TOPIC THEME: The Earth in the Solar System

Grade 5 students will demonstrate **MASTERY** of the following learning standards:

Learning Standard ES 13

Recognize that the earth is part of a system called the "solar system" that includes the sun (a star), planets, and many moons. The earth is the third planet from the sun in our solar system.

Learning Standard ES 14

Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.

Learning Standard ES 15

Describe the changes that occur in the observable shape of the moon over the course of a month.

Big Ideas

The Earth's position in the Solar System creates an environment that sustains life.
The Earth has its own periodic movement, creating day and night, as well as the seasons.

Essential Questions

What is the Earth's position in relationship to the sun and to the other planets in the Solar System?
What are the phases of the moon?
How does the Earth's rotation and revolution affect the Earth's seasons?

Coverage Timeline

- It is recommended that you plan for 12-14 sessions of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

Possible Investigations and Learning Experiences

- Create a proportional model of the solar system starting on the school playground and extending as far as possible. Demonstrate the size of objects (use a pea as the smallest planet, and different size balls for the rest) and the distance between. Make a smaller classroom sized scale model.
- Observe and discuss the changes in length and direction of shadows during the course of a day (position of sun in the sky).
- Develop a moon calendar by observing the sky every night for 30 days and recording the shape of the moon and its relative location across the sky (record the date of the month and the time of observation).

EARTH AND SPACE SCIENCE STRAND – continued…

Suggested Extensions to Learning in Technology/Engineering

- Design and build a sundial and use it to determine the time of day. Explore how accurate it is over time. Determine the conditions under which the sundial does and does not work. (T/E 1.1, 1.2, 2.3)
- Design and create a calendar that illustrates the phases of the moon. (T/E 2.2, 2.3)
- Make a three-dimensional model of the Earth as it rotates around the Sun to demonstrate seasons and changes in night and day. (T/E 1.1,1.2,2.3)
- Create a moon phases flip book.(T/E 1.1, 1.2, 2.2)

Assessments

- Student projects and investigation write-ups
- Moon journal/chart
- Unit tests

Resources:

- BrainPop!
- Science Court series
- Bill Nye videos
- Science Explorer: Weather & Climate Prentice Hall (or similar texts)

LIFE SCIENCE STRAND

UNIT/TOPIC THEME: Plant Structures and Functions and Adaptations of Living Things

Grade 5 students will demonstrate **MASTERY** of the following learning standards:

Learning Standard LS 4

Describe the major stages that characterize the life cycle of the frog and butterfly as they go through metamorphosis.

Learning Standard LS 5

Differentiate between observed characteristics of plants and animals that are fully inherited (e.g., color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by the climate or environment (e.g., browning of leaves due to too much sun, language spoken).

Learning Standard LS 6

Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive (e.g., shape of beak or feet, placement of eyes on head, length of neck, and shape of teeth).

Big Ideas

The balance of nature is maintained by the life cycles of organisms.
Frogs and butterflies grow to adulthood by going through complex life cycles.
The physical appearance of plants and animals is guided by their inheritance as well as their environment.

Essential Questions

What are the major stages that the frog and butterfly undergo during metamorphosis?
How do organisms adapt to their environment in order to survive?
How does the environment affect the survival of the living things within it?
Why do living things look the way they do?

Coverage Timeline

- It is recommended that you plan for 10 sessions of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

LIFE SCIENCE STRAND – continued…

Possible Investigations and Learning Experiences

- Follow the complete life cycle of two organisms that exhibit metamorphoses - such as a frog or a butterfly - using either live organisms or pictures/models.
- Draw pictures of the frog at various stages of development.
- Make frequency tables of the number of students with certain inherited physical traits (e.g., eye color, hair color, earlobe free or attached, and hitch-hiker thumb). Discuss if any of the human inherited traits may represent adaptations from the environment or mutations.

Suggested Extensions to Learning in Technology/Engineering

- Compare natural systems with mechanical systems that are designed to serve similar purposes (e.g., bird's wings and airplane wings). (T/E 2.4)

Assessments

- Student projects and investigation write-ups
- Unit tests

Resources:

- BrainPop!
- Science Court series
- Bill Nye videos
- Plant and/or animal specimens

PHYSICAL SCIENCE STRAND

UNIT/TOPIC THEME: Forms of Energy: Electrical and Magnetic

Grade 5 students will demonstrate **MASTERY** of the following learning standards:

Learning Standard PS 4

Identify the basic forms of energy: heat, electric, magnetic[2].
Recognize that energy is the ability to cause motion or create change.

Learning Standard PS 5

Give examples of how energy can be transferred from one form to another.

Learning Standard PS 6

Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.

Learning Standard PS 7

Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity.

Learning Standard PS 8

Explain how electromagnets can be made, and give examples of how they can be used.

Learning Standard PS 9

Recognize that magnets have poles that repel and attract each other.

Learning Standard PS 10

Identify and classify objects and materials that a magnet will attract and objects and materials that a magnet will not attract.

Big Ideas

Magnetism and electricity are both forms of energy.
Like charges repel; unlike charges attract.
Positive and negative charges cause electricity to flow.
Materials can be conductors or insulators.
Electricity can produce light, heat, and magnetism.

Essential Questions

What happens when electricity flows?
What are electrical fields? How are they different from magnetic poles?
How can we classify materials as either conductors or insulators?

Coverage Timeline

- It is recommended that you plan for 12-14 sessions of instruction, but allow for flexibility based upon resources, student interest, and corresponding opportunities.

[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 STRAND – continued…

Possible Investigations and Learning Experiences

- Rub two pieces of wood together (using mechanical energy) and observe the change in temperature of the wood and in your arm muscles.
- Provide a collection of materials that are good conductors and good insulators. Have students determine each material's electrical conductivity by testing the materials with a simple battery/bulb circuit.
- Balance ring magnets on a pencil. (Note: The shape of a ring magnet obscures the locations of its poles.)
- Provide sealed field detectors (iron filings confined between sheets of plastic or iron filings sealed in oil). Use to show and draw magnetic fields in two and three dimensions.
- Test a variety of materials with assorted magnets. Include samples of pure iron and magnetic steel. Include samples of non-magnetic metals. Mention the two other magnetic metals: pure cobalt and pure nickel. Test a U.S. five-cent coin. Is a U.S. nickel coin made of pure nickel?

Suggested Extensions to Learning in Technology/Engineering

- 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)
- Using graphic symbols draw and label a simple electric circuit. (T/E 2.2)
- Using batteries, bulbs, and wires, build a series circuit. (T/E 1.2, 2.2)
- Design and build a simple game using simple circuits. (T/E 1.2, 2.2)
- Select from a variety of materials (e.g., cloth, cardboard, Styrofoam, plastic, etc.) to design and construct a simple device (prototype) that could be used as an insulator. Do a simple test of its effectiveness. (T/E 1.1, 1.2, 2.2, 2.3)
- Design and construct a simple game or toy (prototype) that works because of electromagnets. (T/E 1.1, 1.2, 2.2, 2.3)
- Make an electromagnet with a six-volt battery, insulated wire, and a large nail. (T/E 1.2, 2.1, 2.2, 2.3)
- Design and build a magnetic device to sort steel from aluminum materials for recycling. (T/E 1.1)
- Design and construct a device that utilizes magnets to lift a metal weight at least six inches off the ground. (T/E 1.1, 1.3, 2.3)

Assessments

- Student projects and investigation write-ups
- Unit tests

Resources:

- BrainPop!
- Science Court series
- Bill Nye videos
- Circuit kits
- FOSS kit, "Magnetism & Electricity" and S.T.E.P Equipment

TECHNOLOGY/ENGINEERING STRAND

UNIT TOPIC/THEME: Simple Machines

Grade 5 students will demonstrate **MASTERY** of the following learning standards:

Learning Standard T/E 1.1

Identify materials used to accomplish a design task based on a specific property (e.g., weight, strength, hardness, 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 1.3

Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge gear, and lever.

Big Idea

Simple machines make life easier by reducing effort (force).

Essential Questions

What is force (effort)?
How does distance affect effort when using a simple machine?
What are the six types of simple machines?
What are the three classes of levers?

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

- Definition of Machines: The simple machines are the lever, pulley, and inclined plane, along with their most basic modifications, the wheel and axle, wedge, and screw. A complex machine is a machine made up of two or more simple machines.
- Design a lever, putting unequal weights on the ends of the balance board. Observe. Now find ways to restore the balance by moving the fulcrum, keeping each weight in the same place. Discuss what happens. (T/E 2.1)
- Identify tools and simple machines used for a specific purpose (e.g., ramp, wheel, pulley, lever).
- Identify tools as levers/ complex simple machines and classify each according to the elements contained within.

Assessments

- Student projects and investigations
- Teacher created tests
- FOSS

TECHNOLOGY/ENGINEERING STRAND - continued…

Resources:

- FOSS Lever & Pulley kit or similar
- Science Court series
- Bill Nye videos
- S.T.E.P Equipment

TECHNOLOGY/ENGINEERING STRAND - continued…

UNIT/TOPIC THEME: Engineering Design

Grade 5 students will demonstrate **MASTERY** of the following learning standards:

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.

Big Idea
When a problem is identified, we can apply our knowledge to solve it.

Essential Question
What features need to be considered when creating a design?

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 the Earth and Space Science Strand
- Design and construct a composting bin being sure to keep design considerations in mind (e.g., aeration, resistance to rot, etc.) (T/E 1.2, 2.1-2.3)
- Use sieves of different mesh sizes to separate coarse and fine materials in a soil sample. Approximate the ratio of fine to coarse material in the sample. Discuss how these different sizes of particles affect the soil. (T/E 1.2)
- Construct a model landform environment to demonstrate the variety of features present in a given land mass. (T/E 1.1,1.2,2.3)
- Design a flow chart to demonstrate how silica from sand is used to make glass. (T/E 1.2)

From the Life Science Strand
- Compare an organism's system with a mechanical system (i.e. bird's wings, maple tree seedlings, airplane wings). (T/E 2.4)

TECHNOLOGY/ENGINEERING STRAND - continued…

From the Physical Science Strand

- Using graphic symbols draw and label a simple electric circuit. (T/E 2.2)
- Using batteries, bulbs, and wires, build a series circuit. (T/E 1.2, 2.2)
- Design and build a simple game using simple circuits. (T/E 1.2, 2.2)
- Select from a variety of materials (e.g., cloth, cardboard, Styrofoam, plastic, etc.) to design and construct a simple device (prototype) that could be used as an insulator. Do a simple test of its effectiveness. (T/E 1.1, 1.2, 2.2, 2.3)
- Design and construct a simple game or toy (prototype) that works because of electromagnets. (T/E 1.1, 1.2, 2.2, 2.3)
- Make an electromagnet with a six-volt battery, insulated wire, and a large nail. (T/E 1.2, 2.1, 2.2, 2.3)
- Design and build a magnetic device to sort steel from aluminum materials for recycling. (T/E 1.1)
- Design and construct a device that utilizes magnets to lift a metal weight at least six inches off the ground. (T/E 1.1, 1.3, 2.3)