State Frameworks and National Standards addressed in Harvard Forest's Schoolyard Ecology Projects

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I. *Massachusetts Science and Technology/Engineering Curriculum Framework*. October 2006. Massachusetts Department of Education.

Learning Standards that apply to Harvard Forest schoolyard projects:

Earth and Space Science-Grades PreK-2

The Weather

3. Describe the weather changes from day to day and over the seasons.

The Sun as a Source of Light and Heat

4. Recognize that the sun supplies heat and light to the earth and is necessary for life.

Periodic Phenomena

5. Identify some events around us that have repeating patterns, including the seasons of the year, day and night.

Earth and Space Science-Grades 3-5

The Weather

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

9. Differentiate between weather and climate

The Water Cycle

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

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

Earth and Space Science-Grades 5-8

Heat Transfer in the Earth System

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.

The Earth in the Solar System

11. Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons.

Earth and Space Science-High School

Matter and Energy in the Earth System

1.5 Explain how the revolution of Earth around the Sun and the inclination of Earth on its axis cause Earth's seasonal variations (equinoxes and solstices).

1.8 Read, interpret, and analyze a combination of ground-based observations, satellite data, and computer models to demonstrate Earth systems and their interconnections.

3. Earth Processes and Cycles (cont.)

3.4 Explain how water flows into and through a watershed. Explain the roles of aquifers, wells, porosity, permeability, water table, and runoff.

3.5 Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.

II. Scientific Inquiry Skills Standards

Scientific literacy can be achieved as students inquire about geologic, meteorological, oceanographic, and astronomical phenomena. The curriculum should include substantial hands-on laboratory and field experiences, as appropriate, for students to develop and use scientific skills in Earth and Space Science, including reading and interpreting maps, keys, and satellite, radar, and telescope imageries; using satellite and radar images and weather maps to illustrate weather forecasts; using seismic data to identify regions of seismic activity; and using data from various instruments that are used to study deep space and the solar system, as well as the inquiry skills listed below.

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.
- Select required materials, equipment, and conditions for conducting an experiment.
- Identify independent and dependent variables.
- Write procedures that are clear and replicable.

- 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.
- Follow safety guidelines.

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.
- Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis.
- State questions raised by an experiment that may require further investigation.

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.
- Use and refine scientific models that simulate physical processes or phenomena.

Life Science (Biology) –Grades PreK-2

Characteristics of Living Things

1. Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.

2. Differentiate between living and nonliving things. Group both living and nonliving things according to the characteristics that they share.

3. Recognize that plants and animals have life cycles, and that life cycles vary for different living things.

Living Things and Their Environment

7. Recognize changes in appearance that animals and plants go through as the seasons change.

8. Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter

Life Science (Biology), Grades 3–5

Characteristics of Plants and Animals

1. Classify plants and animals according to the physical characteristics that they share.

Structures and Functions

2. Identify the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, reproduction, growth, and protection.

3. Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.

Adaptations of Living Things

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).

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.

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

Energy and Living Things

10. 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.

Life Science (Biology), Grades 6-8

Evolution and Biodiversity

10. Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms

12. Relate the extinction of species to a mismatch of adaptation and the environment.

Living Things and Their Environment

13. Give examples of ways in which organisms interact and have different functions within an ecosystem that enable the ecosystem to survive

Energy and Living Things

16. Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

Changes in Ecosystems Over Time

17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.

18. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.

Biology, High School

5. Evolution and Biodiversity

5.2 Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities. Describe the role that geographic isolation can play in speciation.

6. Ecology

Central Concept: Ecology is the interaction among organisms and between organisms and their environment.

6.1 Explain how birth, death, immigration, and emigration influence population size.

6.2 Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.

6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.

6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.

II. Scientific Inquiry Skills Standards (all aspects of Biology Inquiry skills are addressed in HF-sLTER projects as seen in description for Earth and Space science)**.**

Scientific literacy can be achieved as students inquire about the biological world. The curriculum should include substantial hands-on laboratory and field experiences, as appropriate, for students to develop and use scientific skills in biology, along with the inquiry skills listed below.

II. Mathematics Curriculum Framework

Number Sense and Operations-

Grades 1–2

Identify and represent common fractions (1/2, 1/3, 1/4) as parts of wholes, parts of groups, and numbers on the number line. 💻

Compare whole numbers using terms and symbols, e.g., less than, equal to, greater than (<, =, >). 💻

Grades 3–4

4.N.1 Demonstrate an understanding of fractions as parts of unit wholes, as parts of a collection, and as locations on the number line. 💻

Grades 5–6

-Demonstrate an understanding of fractions as a ratio of whole numbers, as parts of unit whole

Patterns, Relations, and Algebra-

Grades PreK-K

K.P.1 Sort and classify objects by color, shape, size, number, and other properties. 💻

Measurement

K.M.1 Recognize and compare the attributes of length, volume/capacity, weight, area, and time using appropriate language, e.g., longer, taller, shorter, same length; heavier, lighter, same weight; holds more, holds less, holds the same amount. 💻

Exploratory Concepts and Skills

- ✓ Explore and use standard units to measure and compare temperature, length, and time.
- ✓ Identify positions of events over time, e.g., earlier, later.

Grades 1–2

-Measure and compare common objects using metric and English units of length measurement, e.g., centimeter, inch.

-Select and correctly use the appropriate measurement tools, e.g. ruler, balance scale, thermometer.

Exploratory Concepts and Skills

✓ Explore measurable attributes of objects, including length, perimeter, weight, area, volume, and temperature. Compare concrete objects using these measures.

✓

✓ **Grades 3–4**

✓ Demonstrate an understanding of such attributes as length, area, weight, and volume, and select the appropriate type of unit for measuring each attribute. 💻

✓ Identify and use appropriate metric and English units and tools (e.g., ruler, angle ruler, graduated cylinder, thermometer) to estimate, measure, and solve problems involving length, area, volume, weight, time, angle size, and temperature. ●

Data Analysis, Statistics, and Probability

Grades 1–2

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

2.D.1 Use interviews, surveys, and observations to gather data about themselves and their surroundings. 💻

2.D.2 Organize, classify, represent, and interpret data using tallies, charts, tables, bar graphs, pictographs, and Venn diagrams; interpret the representations. ●

2.D.3 Formulate inferences (draw conclusions) and make educated guesses (conjectures) about a situation based on information gained from data. ♦

2.D.4 Decide which outcomes of experiments are most likely. ■

Grades 3–4

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

4.D.1 Collect and organize data using observations, measurements, surveys, or experiments, and identify appropriate ways to display the data. 💻

4.D.2 Match a representation of a data set such as lists, tables, or graphs (including circle graphs) with the actual set of data. ●

4.D.3 Construct, draw conclusions, and make predictions from various representations of data sets, including tables, bar graphs, pictographs, line graphs, line plots, and tallies. ♦

Grades 5–6

6.D.1 Construct and interpret stem-and-leaf plots, line plots, and circle graphs. ●

6.D.2 Use tree diagrams and other models (e.g., lists and tables) to represent possible or actual outcomes of trials. Analyze the outcomes. ■

Exploratory Concepts and Skills

- ✓ Select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatter plots.
- ✓ Compare different representations of the same data and evaluate how well each representation shows important aspects of the data.

Grades 7–8

Patterns, Relations, and Algebra

8.P.1 Use tables and graphs to represent and compare linear growth patterns. In particular, compare rates of change and x- and y-intercepts of different linear patterns.

Data Analysis, Statistics, and Probability

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them Select and use appropriate statistical methods to analyze data Develop and evaluate inferences and predictions that are based on data Understand and apply basic concepts of probability

8.D.1 Describe the characteristics and limitations of a data sample. Identify different ways of selecting a sample, e.g., convenience sampling, responses to a survey, random sampling.

8.D.2 Select, create, interpret, and utilize various tabular and graphical representations of data, e.g., circle graphs, Venn diagrams, scatterplots, stem-and-leaf plots, box-and-whisker plots, histograms, tables, and charts. Differentiate between continuous and discrete data and ways to represent them.

8.D.3 Find, describe, and interpret appropriate measures of central tendency (mean, median, and mode) and spread (range) that represent a set of data. Use these notions to compare different sets of data.

Exploratory Concepts and Skills for Grades 7-8

Data Analysis, Statistics, and Probability

- ✓ Make predictions, conduct experiments, and discuss discrepancies to develop understanding of actual vers
- ✓ us predicted outcomes.

Grades 9–10

Measurement Understand measurable attributes of objects and the units, systems, and processes of measurement Apply appropriate techniques, tools, and formulas to determine measurements

10.M.1 Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume.

Data Analysis, Statistics and Probability

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them . Select and use appropriate statistical methods to analyze data . Develop and evaluate inferences and predictions that are based on data

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

10.D.1 Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plots, box-and-whisker plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.

10.D.3 Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.

Grades 11–12

Data Analysis, Statistics and Probability

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them Select and use appropriate statistical methods to analyze data Develop and evaluate inferences and predictions that are based on data

12.D.1 Select an appropriate graphical representation for a set of data and use appropriate statistics (e.g., quartile or percentile distribution) to communicate information about the data.

III. *National Science Education Standards*

National Research Council. 1996. Washington D.C. National Academy Press.

Grades K-4:

Science as Inquiry -Standard A: “As a result of activities in grades K-4, all students should develop

- Abilities necessary to do scientific inquiry:

- Ask a question about objects, organisms, and events in the environment.
- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use Data to construct a reasonable explanation
    - This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations. After students propose and explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others.
- Communicate investigations and explanations
    - Students should begin developing the abilities to communicate, critique, and analyze their work and the work of other students. This communication might be spoken or drawn as well as written.

- Understanding about scientific inquiry:
    - Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
    - Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.
    - Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).Good explanations are based on evidence from investigations.
    - Scientists review and ask questions about the results of other scientists' work.

Life Science-Content Standard C: AS a result of activities in grades K-4, all students should develop understanding of:

- The characteristics of organisms
    - Organisms have basic needs. For example, animals need air, water, and food. Plants require air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.
    - Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.
- Life cycles of organisms
    - Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details in this life cycle are different for different organisms.
- Organisms and environments
    - An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and number of other organisms present, the availability of food and resources, and the physical characteristics of the environment. When the environment changes, some plants and animals survive and reproduce and others die or move to new locations.
    - All organisms cause changes In the environment where they live. Some of these changes are detrimental to the organism or other organisms, whereas others are beneficial.

Earth and Space Science-Content Standard D:

- Objects in the sky
    - The sun provides the light and heat necessary to maintain the temperature of the earth.
- Changes in earth and sky
    - Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind directions and speed, and precipitation.

Science and Technology-Content Standard E:

- Understanding about science and technology
    - People have always had questions about their world. Science is one way of answering questions and explaining the natural world.
    - Women and men of all ages, backgrounds, and groups engage in a variety of scientific and technological work.
    - Tools help scientists make better observations, measurements, and equipment for investigations.

Science in Personal and Social Perspectives-Content Standard F:

- Types of resources
    - Some resources are basic materials such as air, water, and soil..
- Changes in Environments
    - Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive and their quality of life.
    - Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad.
    - Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods.

History and Nature of Science-Content Standard C

- Science as a human endeavor
    - Although men and women using scientific inquiry have learned much about the objects, events, and phenomena in nature, much more remains to be understood. Science can never be finished.
    - Many people choose science as a career and devote their entire lives to studying it.

Grades 5-8:

Science as Inquiry-content Standard A:

- Abilities necessary to do Scientific Inquiry
    - Identify questions that can be answered through scientific investigations
    - Conduct a scientific investigation

        - Students should develop general abilities, such as systematic observation, making accurate measurements, and identifying and controlling variables. They should also develop the ability to clarify their ideas that are influencing and guiding the inquiry, and to understand how those ideas compare with current scientific knowledge. Students can learn to …execute investigations, interpret data, use evidence to generate explanations, propose alternative explanations, and critique explanations and procedures.
    - Use appropriate tools and techniques to gather, analyze, and interpret data
        - The use of computers for the collection, summary, and display of evidence is part of this standard. Students should be able to access, gather, store, retrieve, and organize data, suing hardware and software designed for these purposes.
    - Develop descriptions, explanations, predictions, and models using evidence
        - Students should base their explanation on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from description-providing causes for effects and establishing relationships based on evidence and logical argument. This standard requires a subject matter knowledge base so the students can effectively conduct investigations, because developing explanations establishes connections between the content of science and the contexts within which students develop new knowledge.
    - Think critically and logically to make the relationships between evidence and explanations.
        - Thinking critically about evidence includes deciding what evidence should be used and accounting for anomalous data. Specifically, students should be able to review data from a simple experiment, summarize the data, and form a logical argument about the cause-and –effect relationships in the experiment.
    - Recognize and analyze alternative explanations and predictions
    - Communicate scientific procedures and explanations.
        - With practice, students should become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations.
    - Use mathematics in all aspects of scientific inquiry
        - Mathematics can be used to ask questions; to gather, organize, and present data; and to structure convincing explanations.
- Understandings about Scientific Inquiry
    - Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances.

Life Science-Content Standard C:

- Regulation and Behavior
    - All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing environment.
    - Regulation of an organism's internal environment and changing physiological activities to keep conditions within the range required to survive.
    - Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many

levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

- Populations and ecosystems
    - A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose and ecosystem.
    - For ecosystems the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
    - The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic factors and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.
- Diversity and adaptations of organisms
    - Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
    - Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival.

Earth and Space Science- Content Standard D:

- Structure of the earth system
    - Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- Earth in the solar system
    - The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotations on its axis and the length of the day.

Science in Personal and Social Perspectives- Content Standard F:

- Personal health
    - Natural environments may contain substances that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.
- Science and technology in society
    - Scientists and engineers work in many different settings, including colleges and universities, businesses, and industries, specific research institutes, and government agencies.

History and Nature of Science-content Standard G:

- Science as a human endeavor
    - Women and men of various social and ethnic backgrounds-and with diverse interests, talents, qualities, and motivations-engage in the activities of science. Some scientist work in teams, and some work alone, but all communicate extensively with others.
    - Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity-as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.
- Nature of science
    - Scientists formulate and test their explanations of nature using observations, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation,. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.

Grades 9-12

Science as Inquiry-Content Standard A:

- Abilities necessary to do scientific inquiry
    - Identify questions and concepts that guide scientific investigations.
    - Conduct scientific investigations
        - Designing and conducting a scientific investigation requires introduction to the major concepts in the area being investigated, proper equipment, safety precautions, assistance with methodological problems, recommendations for us of technologies, clarification of ideas that guide the inquiry, and scientific knowledge obtained from sources other than the actual investigation. The investigation may also require…student organization and display of data; student review of methods and explanations; and a public presentation of the results with a critical response from peers. Regardless of the scientific investigation preformed, students muse evidence, apply logic, and construct an argument for their proposed explanations.
    - Use technology and mathematics to improve investigations and communications.
        - The use of computers for the collection, analysis and display of data….charts and graphs are used for communicating results. Mathematics play an essential role in all aspects of an inquiry. For example,.. formulas are used for developing explanations, and charts and graphs are used for communicating results.
    - Communicate and defend a scientific argument
        - Students in school science programs should develop the abilities associated with accurate and effective communication. These include writing and following procedures, expressing concepts, reviewing information, summarizing data, using language appropriately, Developing diagrams and charts, explaining statistical analysis, speaking clearly and logically, constructing a reasoned argument, and responding appropriately to critical comments.

- Understanding bout scientific inquiry
    - Scientists usually inquire about how physical, living or designed systems function. Conceptual principles and knowledge guide scientific inquiries. Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.
    - Scientists rely on technology to enhance the gathering and manipulation of data. New techniques and tools provide new evidence to guide inquiry and new methods to gather data, thereby contributing to the advance of science.
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Life Science: Content Standard C:

- Interdependence of organisms
    - Organisms both cooperate and compete in ecosystems.
    - Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.
    - Human destruction of habitats through …pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.
- Matter, energy and organization in living systems
    - The energy for life primarily derives from the sun. Plants capture energy by absorbing light…can be used as sources of energy for life processes.
- Behavior of organisms
    - Organisms have behavioral responses to internal changes and to external stimuli.

Earth and Space Science- Content Standard D:

- Energy in the earth system
    - Global climate is determined by energy transfer from the sun at and near the earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the earth's rotation, and static conditions such as the position of mountain ranges and oceans.

Science and Technology-Content Standard E

- Understandings about science and technology
    - Creativity, imagination, and a good knowledge base are all required in the work of science.

Science in Personal and Social Perspectives

- Environmental quality
    - Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.
    - Materials from human societies affect both physical and chemical cycles of the earth.
- Natural and human induced hazards

- Science and technology in local, national, and global challenges
    - Understanding basic concepts and principles of science…should precede active debate about the economics, policies, politics, and ethics of various science and technology-related challenges.
    - Humans have a major effect on other species.

History and Nature of Science

- Science as a human endeavor
    - Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question. Pursuing science as a career or as a hobby can be both fascinating and intellectually rewarding.
    - Scientists have ethical traditions. Scientists value peer review, truthful reporting about the methods and outcomes of investigations, and making public the results of work.
    - Science is not separate from society but rather science is a part of society.
- Nature of scientific knowledge
    - Scientific explanations must meet certain criteria. First and foremost, they must be consistent with experimental and observational evidence about nature, and must make accurate predictions, when appropriate, about systems being studied. They should also be logical, respect the rules of evidence, be open to criticism, report methods and procedures, and make knowledge public.
    - Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is , in principle, subject to change as new evidence becomes available.
- Historical perspectives
    - Usually, changes in science occur as small modifications in extant knowledge.